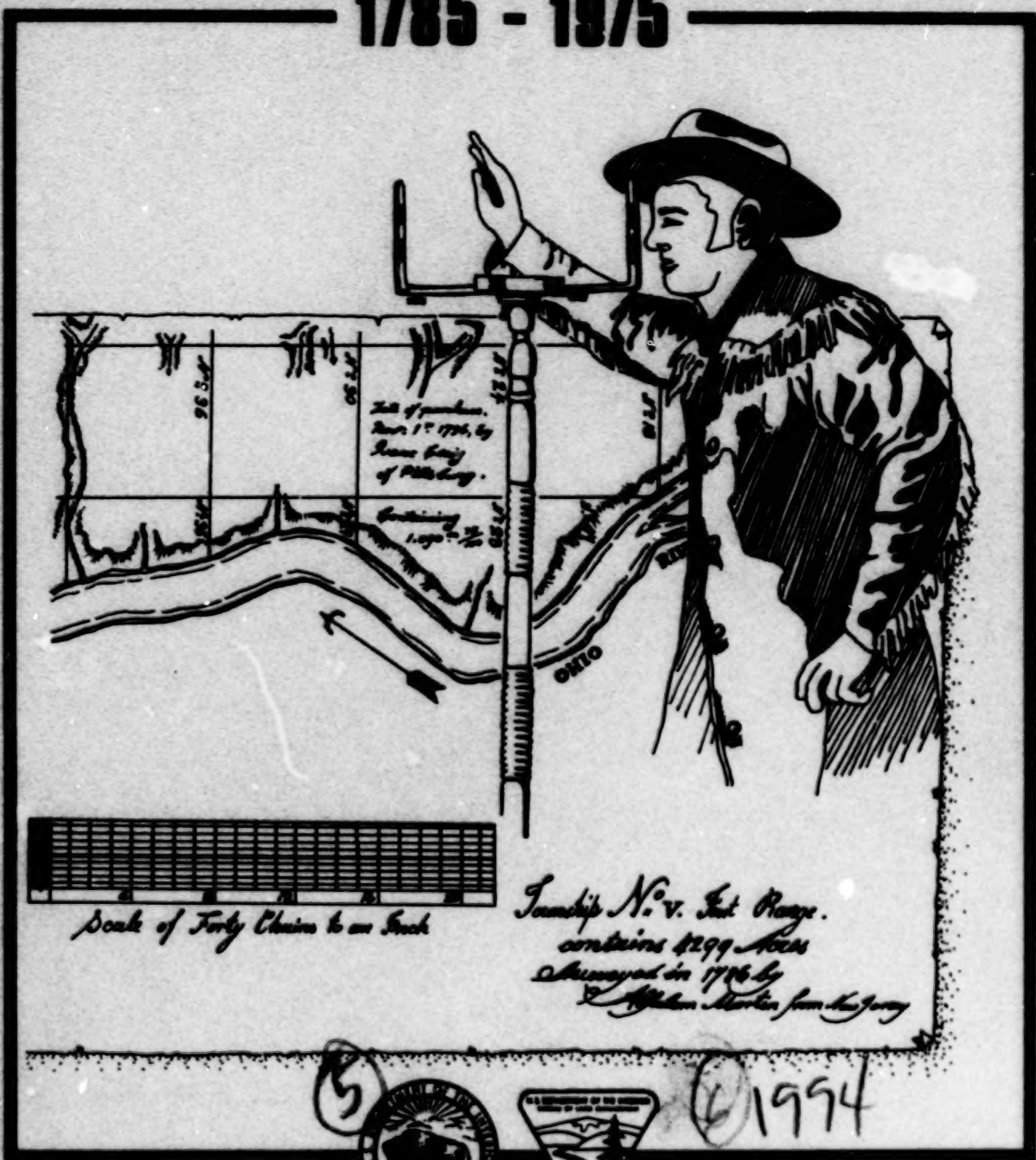


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SURVEYS AND SURVEYORS OF THE PUBLIC DOMAIN

1785 - 1975



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FRONTISPIECE



In 1914, surveyors called this "typical mountain work in the West." The mountains are in Washington State. The instrument, a solar compass with telescopic attachment, is being used by Jerry Campbell.

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**SURVEYS AND SURVEYORS
OF THE PUBLIC DOMAIN
1785-1975**

by

Lola Cazier

DEDICATION

Over the years since 1785 there have been perhaps a few thousand public land surveyors—each one worthy of his own story. The names of many of them appear in these pages. Yet, the story of all those who are not mentioned is here too, for it took all of them—the many unnamed no less than those written about—to mark the lines and corners of the public lands. They are the people who have done, and are still doing, the work upon which rests the title to the public lands.

CONTENTS

Foreword

Acknowledgments

	Page
1. Ancient Surveys	1
2. Colonial America	5
3. The Beginning of the Rectangular Surveys	13
4. The Ellicotts and Benjamin Banneker	21
5. The Proving Ground	25
6. Congressional Authority for Management of the Public Lands	35
7. The Refinement of the Rectangular Survey System	47
8. Pioneer Surveyors	53
9. The Far West	65
10. In the Vanguard	87
11. The Direct System	97
12. About Cadastral Surveys	107
13. Alaska	145
14. The Early Years of the Direct System	153
15. Modernization of the System	195
16. News, Notes, and Anecdotes	205
17. The Bureau of Land Management.....	213
References	219
Index	223

FOREWORD

Cadastral surveys are performed to create, mark, and define, or to retrace the boundaries between abutting land owners, and, more particularly, between land of the Federal Government and private owners or local governments. As referred to here, cadastral surveys were performed only by the General Land Office during its existence and by the Bureau of Land Management. The Bureau of Land Management is the only agency that is currently authorized to determine the boundaries of the public lands of the United States.

Proper understanding of the basis for performance of cadastral surveys includes an understanding of the history of the public land surveys. An understanding of that history requires some consideration of the people who performed these surveys and of the people whose land was affected by them.

These chapters were written to be used as an aid in training cadastral surveyors in the application of surveying principles. The learner is expected to gain from the factual material on survey laws and their formation, as well as from a study of the people who performed the surveys. Many of the men who had an important role in the history of cadastral surveying are still living, but only those who have retired are included in the present document.

ACKNOWLEDGMENTS

The assistance of many persons was necessary to the completion of this book. It would be impossible to thank them all, but I would like to express my gratitude to at least a few of those who generously helped me in this project.

Without James A. Simpson, leader of the Cadastral Survey Training Staff, BLM, it would not have been started, much less finished. Thomas A. Tillman, civil engineer, BLM (retired), contributed valuable assistance, criticism, and suggestions. Renee Munoz improved the manuscript by her thoughtful and constructive editing. Line drawings and illustrations were done by Kasper Schaff, Herman E. Weiss, Diane Colcord, and Sharon Foster. F. Mason, Teledyne Gurley, Troy, N.Y., loaned me a photograph of Arthur D. Kidder and Joseph Thoma. W. R. (Roy) Bandy, now deceased, permitted me to use many photographs taken during his long career as a cadastral surveyor. Theodore VanderMeer, John S. Knowles, and Roger Wilson, now deceased, all long-time cadastral engineers, also shared their personal photographs and reminiscences with me as did C. Albert White, supervisory land surveyor, BLM (retired), and P. T. Reilly, who worked on various cadastral survey crews during the 1930's. David Nelson, cadastral surveyor, Alaska State Office, BLM, and Hobart Hyatt, cadastral surveyor, Alaska State Office, BLM (retired), also permitted me to use their personal photographs. Clark Gumm, chief, Division of Cadastral Surveys, BLM (retired), permitted me to use photographs taken by many surveyors in many places that he had gathered and preserved over a period of years. Last, and most important, special thanks to my husband, Dell Cazier, who kept me "on line."

✓

ANCIENT SURVEYS

When the first individual felt the desire to possess land, the need for the work of a cadastral surveyor—to define boundaries and property lines—became inevitable. This occurrence is lost in antiquity, as is the moment man first perceived the principle of the wheel, but it is also noteworthy.

Before there was recorded history, cave dwellers claimed their homes and hunting grounds by right of occupancy and/or weapon (the club). Disputes over boundaries have always, along with religion, politics, and taxes, awakened people's hidden passions. Thus, to the surveyor must go the credit for the lessening of disagreements over property lines.

Surveying itself has no "point of beginning." We know that an ancient Assyrian clay tablet exists. It was found at Nuzi, near Kirkuk, and dates from the dynasty of Sargon of Akkad, well over 5,000 years ago. Scratched into its surface is a map that shows a surveyed part of what is now Iran (northern Mesopotamia).³²

NILE VALLEY

Under the Pharaohs, the Egyptians devised extremely precise methods of measurement. The Great Pyramid of Giza (Khufu or Cheops) is the most famous example. Its base is oriented in the cardinal directions. The four sides (9,068.8 inches) have an average of just one-sixteenth of an inch in length and 12 seconds in angle from a perfect square. It was constructed about 4700 B.C.¹¹⁴ No record exists today of the methods the Egyptians used, nor of their equipment; we do know, however, that they were concerned with the survey of land lines for purposes of taxation. The land in the Nile Valley had to be surveyed repeatedly because of the river's annual flooding.

Three or four thousand years ago, the Babylonians took surveying seriously. There are in existence today a few of the boundary stones set during that period. One of them has much carving upon it, most of which has been translated. It refers to the size of the land, five gur of cornland, measured by the great cubit. The stone gives the district, the province, and the location. The name of the surveyor is also noted, along with the fact that it was an official survey and established the land as the property of Gula-Eresh. The translation also gives, at great length, numerous curses to befall anyone so foolish as to move the stone.¹¹⁷

BIBLICAL MEASUREMENT

Long before the reign of Caesar, the first five books of the Old Testament were written. These five books, the Pentateuch, at one time consisted of four major documents that were combined into a single literary unit about 400 B.C.³¹ Many times within the Pentateuch and in the rest of the Bible, references are made to land survey:

And as for the western border, ye shall even have the great sea for a border; this shall be your west border.

Numbers 34: 6

And the border shall go down to Jordan, and the goings out of it shall be at the salt sea; this shall be your land with the coasts thereof round about.

Numbers 34: 12

Then said I, Whither goest thou? And he said unto me, To measure Jerusalem, to see what is the breadth thereof, and what is the length thereof.

Zechariah 2: 2

And the city lieth foursquare, and the length is as large as the breadth: and he measured the city with the reed, twelve thousand furlongs. The length and the breadth and the height of it are equal.

Revelation 21: 16

And he measured the wall thereof, an hundred and forty and four cubits, according to the measure of a man, that is, of the angel.

Revelation 21: 17

And there are more: 1 Samuel 14: 14 describes half an acre of land, Isaiah 5: 10 discusses the yield from 10 acres of vineyard, and both Ezekiel 40: 5 and 44: 13 described the long cubit—a cubit and a handbreadth.

Biblical units of measure were simple and rather inexact. For the most part they consisted of approximates arrived at by the use of one's body. The cubit was the length of a man's arm from his elbow to his extended finger tip—about 18 inches. A span was the reach of a man's outstretched hand, from finger tip to finger tip, or about 9 inches. (Two spans equalled 1 cubit.) A palm was all four fingers, or about 3 inches, and a finger was about three-fourths of an inch.

In Ezekiel 40: 5 and 43: 13, a long cubit is mentioned, comparing it to a cubit and a hand-breadth. Fathoms are mentioned in Acts 27: 28. This was the length of a man's outstretched arms, or about 6 feet.

The Bible contains many other references to the instruments used by land surveyors in ancient times:

I lifted up mine eyes again, and looked, and behold a man with a *measuring line* in his hand.

Zechariah 2: 1

When he prepared the heavens, I was there: when he set a *compass* upon the face of the depth.

Proverbs 8: 27

Thus he showed me: and, behold, the Lord stood upon a wall made by a *plumbline*, with a plumbline in his hand.

And he brought me thither, and, behold, there was a man, whose appearance was like the appearance of brass, with a *line of flax* in his hand, and *measuring reed*; and he stood in the gate:

Ezekiel 40: 3

He measured the east side with the *measuring reed*, five hundred reeds, with the *measuring reed* round about.

Ezekiel 42: 16

He measured the north side, five hundred reeds, with the *measuring reed* round about.

Ezekiel 42: 17

He measured the south side, five hundred reeds, with the *measuring reed*.

Ezekiel 42: 18

He turned about to the west side, and measured five hundred reeds with the *measuring reed*.

Ezekiel 42: 19

The reed was an instrument used in measuring, and, according to Ezekiel 40: 5, it was 6 cubits long. In the first book of Samuel 14: 14, the measurement of land was related to the area a team of oxen could plow in a day. In some places, an acre was the part of a field that could be seeded in barley in a day. In Mesopotamia the meaning of acres, as used in Isaiah 5: 10, was about two-fifths of our present acre.³¹

THE GROMA

A surveying instrument called a groma was found in the ruins of Pompeii. It was of the type used by the Romans in dividing land to be distributed to veterans. The groma had four arms,

set at 90 degrees to one another, with which the corners of rectangular plots were established. The Roman system of land subdivision was called *agro centuriato*—land divided into hundreds.³² Julius Caesar ruled Rome when *agro centuriato* was introduced. He died 44 years before the birth of Christ, but the subdivision pattern created by different land uses under this survey system is still visible from the air.³³

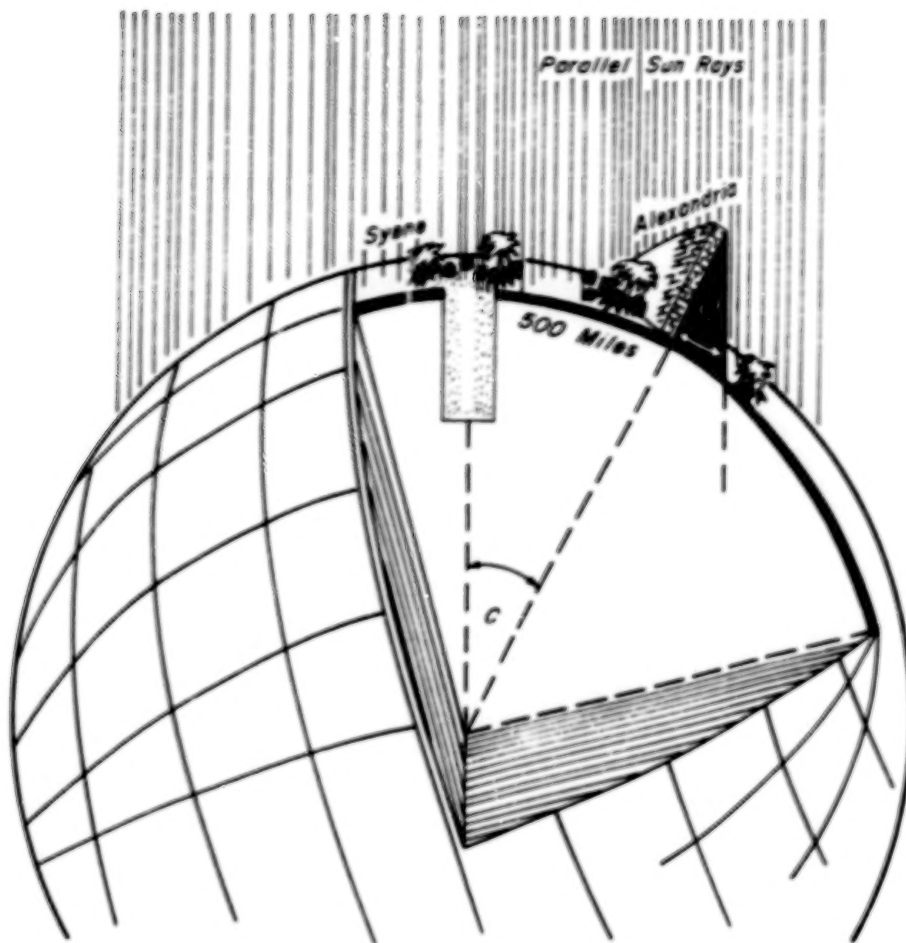
ERATOSTHENES

About 500 years before the birth of Christ, the Greek philosopher and mathematician Pythagoras suggested that the Earth might be spherical rather than flat. Eratosthenes of Cyrene, who lived from 276 until 196 B.C., believed Pythagoras was correct. Eratosthenes was a learned man who became the head of the Alexandrian Library. His intellectual curiosity was aroused when he discovered that, at the peak of the summer solstice, the sun illuminated a deep vertical well in Syene. At noon, on the longest day of the year, Eratosthenes measured the angle of the shadow cast by a vertical wall in Alexandria. It was equal to one-fiftieth of a circle. He thought that Alexandria and Syene were on a direct north-south line, and he knew the accepted distance between the two cities. Based upon his observations, his theory was that the distance between the cities was equal to one-fiftieth of the circumference of the Earth.

Eratosthenes came very close. He used units of length called *stadia*, and, because of compensating errors, arrived at a distance of 24,662 miles. Since the Earth is not a perfect sphere, and since Syene and Alexandria are not exactly the distance apart that he used, nor are they on a perfect north-south line, he was a little off in his estimation—the precise figure is 24,899 miles.³²

This was the first attempt to find the circumference of the Earth by measuring the arc of a meridian. It was quite a feat in the advancement of surveying. The only thing wrong was that people could not believe that the Earth was that large. Until the close of the 15th century, geographers would not accept the findings of Eratosthenes. Instead, they used the calculations of Poseidonius (130 to 51 B.C.) and came up with a circumference of 18,000 miles.³²

During the Middle Ages, the church used the 18,000-mile figure to help convince people that Jerusalem was the center of the world. The maps of that period are narrow in concept. They are often called "T in O" maps, due to their stylized depiction of what the church wanted the world to look like.²⁷



Eratosthenes' application of basic geometry in determining the circumference of the Earth.

DOMESDAY BOOK

When William the Conqueror invaded England in 1066, he changed the existing manorial land tenure system to the feudalism of France.¹¹⁸ Under this new system, the lords of the manors paid a fixed sum to the king.

About 20 years later, William ordered a survey of the lands of England so that there might be a more accurate assessment of the sum he was to receive. The survey was completed and its results were published as the "Domesday Book." It was, in fact, a cadastral survey—a description of the land, with the names of the owners and the extent, nature, and value of their holdings.¹²

THE INCAS

During the 11th to 14th centuries, while European Crusaders tried to free the Holy Land from the Muslims, the Incas in South America were surveying land and constructing cities, pyramids, bridges, and an extensive system of roads.

Using methods unknown to us, they developed terraces on the hillsides for cultivation and built tremendous irrigation works. Though they had no iron or steel tools, there are canals they built that can still be traced for miles. At Cajamarca, a canal that was cut in solid rock extended for more than a mile. At one place they cut the canal in a zig-zag pattern; apparently, this was one of their methods



Facsimile of a T in O map showing the usual depiction of the world in the Middle Ages. Jerusalem was shown at the center of the world, and the Asian location of Paradise gave us the phrase "to orient a map."

of controlling the flow of water. At Huandoval, the Incas built two canals that met and crossed, one above the other. There was once even a third canal below the other two.²³

The ancient Inca fortress city of Machu Picchu, situated at 7,000 feet above sea level, near a mountain top, was built of huge blocks of stone. No cement was used in its construction, but the stones were so carefully fitted that some of the walls and stairs are still intact and are plainly visible in aerial photographs.¹⁸

PORTUGUESE EXPLORATION

The real beginning of European exploration took place in the 15th century during the time of Prince

Henry the Navigator (A.D. 1394-1460). Through Prince Henry's farsighted effort, Portugal began exploring the seas at least 50 years before the rest of Europe.

One of the major factors in Portugal's expansion of travel to the unknown was the discovery of the Azores and the growth of the Portuguese settlement there. Christopher Columbus lived there with his wife's family, where his father-in-law taught him to use navigational and surveying instruments. Undoubtedly, it was in the Azores that Columbus first dreamed of sailing farther than man had sailed before.³²

COLONIAL AMERICA

THE NEW WORLD

Shortly after Columbus' famous voyage, an Italian navigator in the service of England, John Cabot (Giovanni Caboto), discovered the coast of North America in 1497. Soon after, Juan Ponce de Leon explored Florida and claimed it for Spain. In 1519 Hernando Cortez began to explore and conquer Mexico, also on behalf of Spain. One year later, Ferdinand Magellan sailed through the strait that bears his name and thus confirmed the theory that the world was round.

During the next 20 years or so, Lower California and the Gulf of California were found and explored. Coronado explored a large area north of the Rio Grande and claimed it for Spain. The Grand Canyon was discovered by Don Garcia Lopez de Gardenas, and Hernando de Soto began to explore the Mississippi River.

On the evening of November 16, 1532, the last Inca king of Peru, Atahualpa, was ambushed and taken prisoner by Francisco Pizarro. The Inca army was overwhelmed and scattered. In 3 or 4 hours the strength of the most powerful empire in the New World was broken. The riches of Peru went to Spain, and a civilization—recognized as remarkable even by those who destroyed it—was ended.²³

At about this same time, a 21-year-old publisher named Gemma Frisius issued the first edition of "Cosmographia," written by Peter Apian. The second edition, published in 1533, detailed a surveying method Frisius claimed was completely new. It was a way of surveying a large area without direct measurement. The idea was that if all angles and the length of one side were known, the lengths of the other two sides of a triangle could be determined on paper.

TRIANGULATION

Although the ancient Greeks probably originated the idea of triangulation, Frisius was the first to publish it. Some 80 years later, the formula was finally put to actual use. In 1615, a Dutch mathematician named Willebrord Snell, a professor at Leyden University, measured a base line and used triangulation to determine the arc of a meridian.³²

Most land surveyors in the early 17th century did not have the training and background in

mathematics that Snell had. It was to compensate for the fact that the geometrical devices used in triangulation were beyond their grasp that the plane table became popular. Surveyors of that time also possessed the compass, chain, astrolabe, telescope, and a forerunner of the theodolite.³²

AMERICAN COLONIES

About 20 years after the first Spanish colony in America was founded at St. Augustine, Florida, in 1565, Sir Walter Raleigh asked the famous mathematician and surveyor Thomas Harriot to accompany British naval commander Sir Richard Greynville to America. The voyage was successful and Harriot surveyed parts of what was to become the State of Virginia.¹²⁵

Jamestown, the first permanent English colony in America, was founded by the Virginia Company in 1607. About the time the Dutchman Snell determined a meridional arc by triangulation, the headright system of land tenure was adopted in Virginia. Under this system, each person who paid his own or someone else's transportation to America from England was granted 50 acres of land.¹

In 1620 Elder William Brewster brought several books to America with him on the *Mayflower*. Among them was a work on surveying. Although there is no record of which book it was, Aaron Rathbone's "The Surveyor," which had been published in London in 1616, was well thought of at the time,¹²⁵ and could possibly have been the book Brewster brought to the New World.

New England settlers were granted tracts of 10 to 100 acres by the general courts. The English officials who made these "generous" grants could, on occasion, be even more lavish; they voted themselves tracts of from 1,000 to 9,000 acres.¹ The surveying of all these new tracts of land was vitally important to the colonists.

COLONIAL SURVEYORS

Nathaniel Foote was one of the first American colonial surveyors. He surveyed in Massachusetts but left there in 1634, going by way of the Connecticut River, to settle Wethersfield, Connecticut. Foote laid out the town common and home lots. Later, he established the Hartford-Wethersfield boundary line.



George Washington as a surveyor.



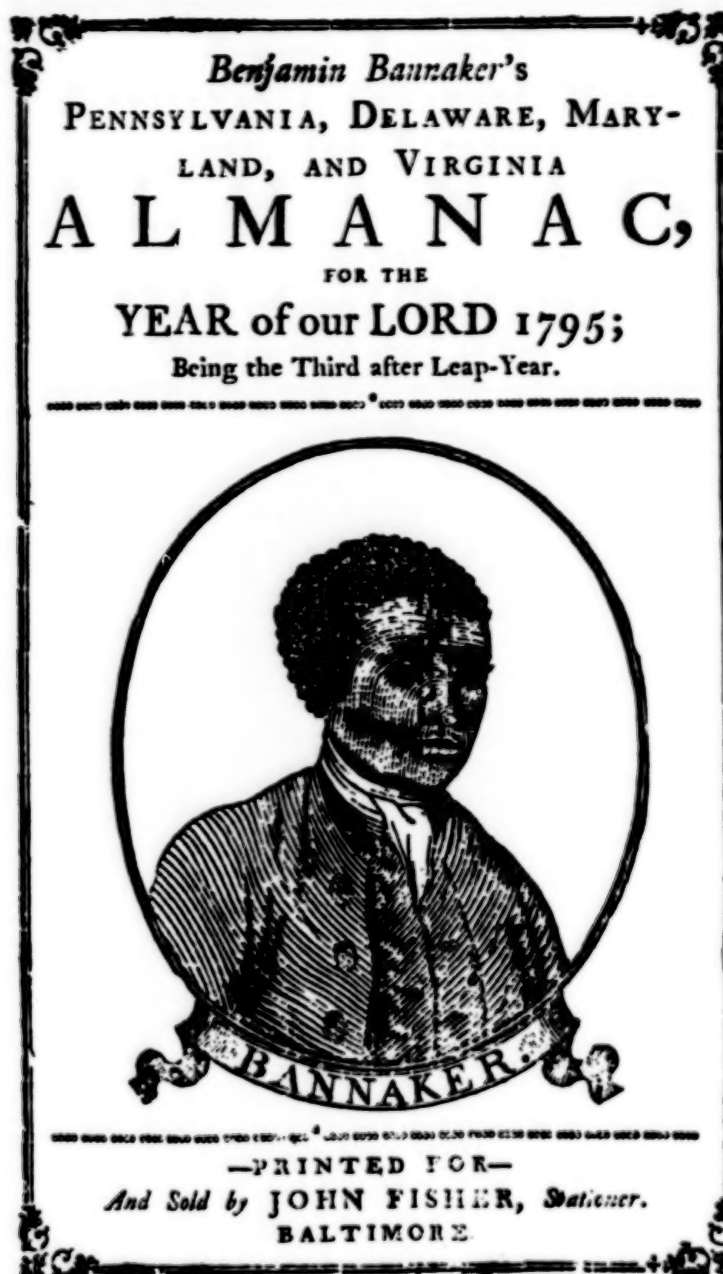
Roger Sherman became the surveyor of Litchfield County, Connecticut, in 1745. Sherman was unique in that he was the only person to sign all four documents involved in the establishment of this country.

In 1715, John Chandler surveyed more than 10,000 acres of land, "adjoining to the said Township of Hadley on the North, on Connecticut [sic] river Westerly and on Springfield Southerly. The Lines are run by the needle of my instrument, allowing no variation—Protracted by a scale of 200 perch to an inch. . . ."133

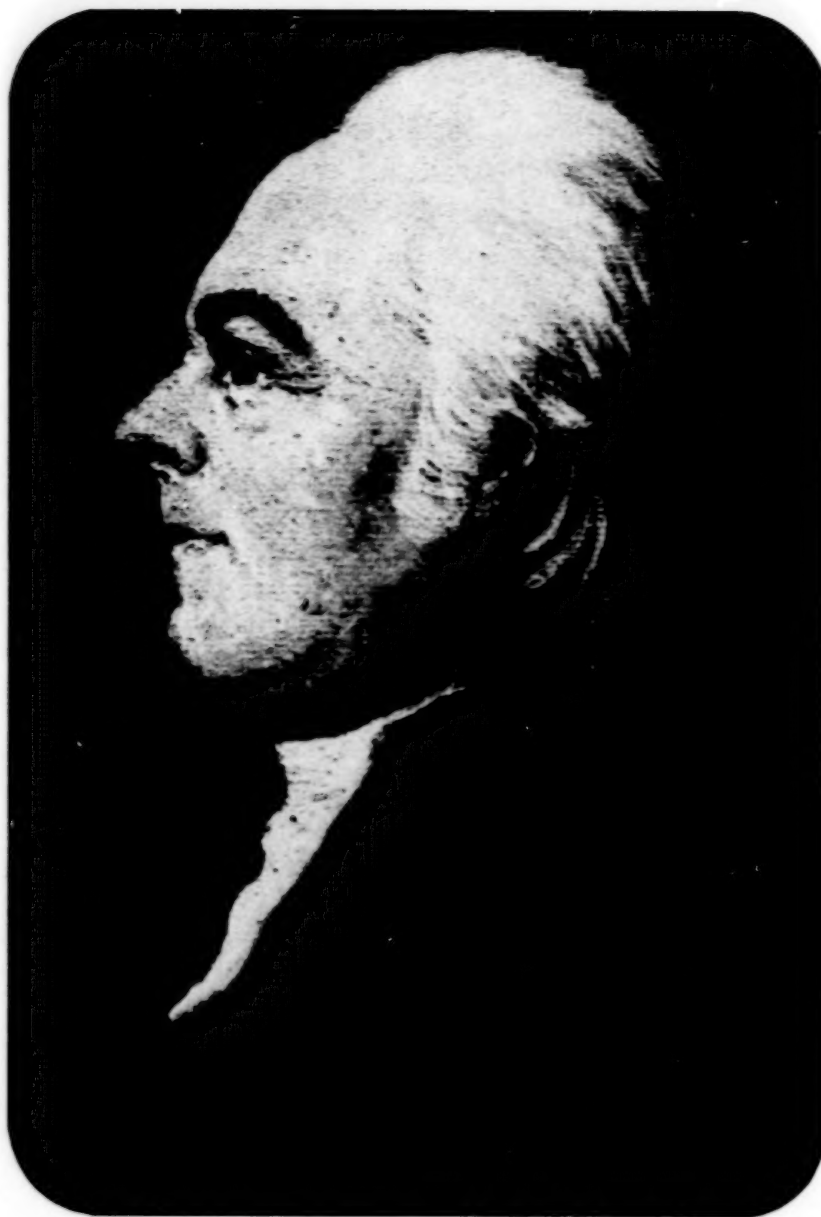
Fifteen years later, during the summer of 1730, Timothy Dwight completed the survey of a plot of land containing 200 acres, "adjoining to the South Side of Chickabey River on both sides of

Chickabey brook by order of the Great and General Court or Assembly of the Province of the Massachusetts Bay Begun and Held at Salem August 28, 1729. . . ."133

During the colonial period, Augustine Herrman surveyed and made maps of Maryland and Virginia, Andries Hudde surveyed and mapped New Amsterdam, and Solomon Saffrey and Nathaniel Woodward ran the boundary between Rhode Island and Massachusetts. Even though the instruments they used were rough and crude by



Portrait of Benjamin Bannaker on the cover of his 1795 almanac.



A portrait of Andrew Ellicott.

present standards, these men did a creditable job of surveying, as did Daniel Leeds, surveyor general of West Jersey Province (New Jersey), and Quaker Surveyor General Edward Penington of Pennsylvania.¹²⁵

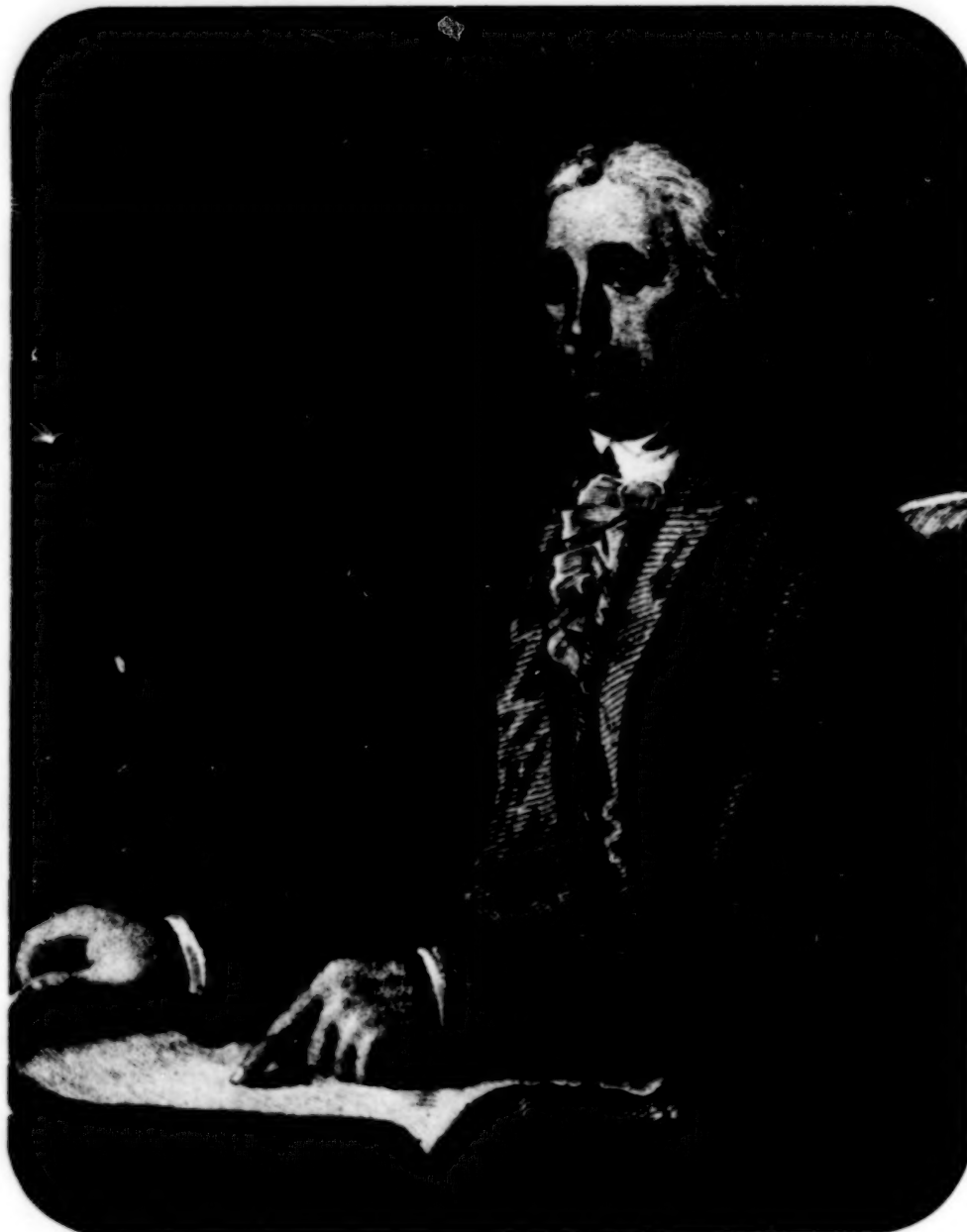
In colonial times, many schoolmasters taught evening classes so that those who could not attend school during the day could receive an education. Surveying and navigation were said to be the most popular mathematical subjects taught. This may have been due to the fact that the bounds of a vast new land were in the process of being marked. And,

because the land grants were often unclear, the subject of surveys and land lines was of great importance in the everyday life of the colonists. One of the people most admired in a colonial community was the land surveyor, or the "boundsgoer." Young boys often trailed along as the surveyors ran their lines. Many of them learned the fundamentals of the skill as they walked beside the boundsgoer.⁶

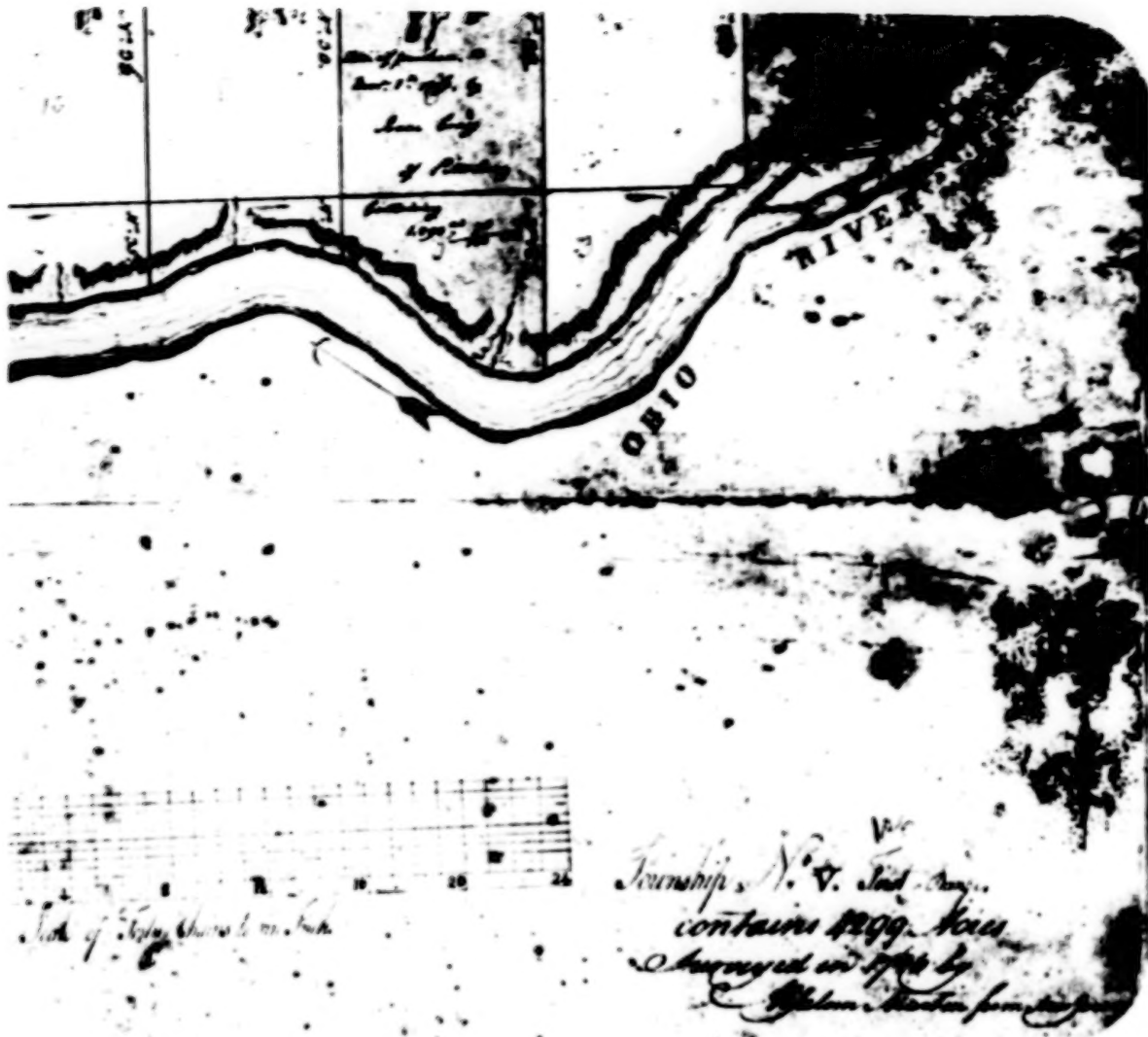
John Jenkins, Sr. (1728-85) and his son John, Jr. (1751-1827) worked as a survey team. In between fighting the Indians, they surveyed the

area in northeastern Pennsylvania known as the Wyoming Valley.¹²⁶ This rich anthracite region was claimed by both Pennsylvania and Connecticut. The Susquehanna Company was formed in 1753, in Connecticut, to develop and settle the valley. This settlement resulted in the Pennamite Wars. The military leader of the Connecticut settlers was Zebulon Butler. In 1778, during the American Revolution, Loyalist Commander John Butler and some Indian allies massacred the Connecticut settlers. Perhaps this is why the land claim conflict was finally decided in favor of Pennsylvania.

Abraham Clark (1726-94) of New Jersey was a surveyor, but he is better remembered as a signer of the Declaration of Independence. Roger Sherman (1721-93), also a signer, was a county surveyor in Connecticut from 1745 to 1758. He was the only person who signed all four of the documents used in founding the United States of America: the Articles of Association (1774), the Declaration of Independence (1776), the Articles of Confederation (1781), and the Constitution (1787).¹²⁶



An engraved portrait of David Rittenhouse.



Township 5, first range, Old Seven Ranges. Surveyed by Absalom Martin of New Jersey in 1786.

Joshua Fry, another colonial surveyor was born in England and attended Oxford University. In about 1720, he emigrated to Virginia, and surveyed along the Carolina border with the deputy surveyor of Virginia's Albemarle County, Peter Jefferson, Thomas Jefferson's father. (The Jeffersons included many men who were surveyors besides Peter. Peter's grandfather had also been a surveyor, and Thomas Jefferson himself later became the surveyor of Albemarle County.³²)

When Fry was professor of mathematics at William and Mary College, he approved George Washington's registration as the surveyor of newly

created Culpepper County. George Washington was just 17 years old when the registration was approved, but he was already an experienced surveyor. When only 16, he crossed the Blue Mountains with veteran surveyor James Genn, surveying land for Lord Fairfax in 1747 and 1748.¹²¹

In the early 1750's, then-Colonel Joshua Fry led the Virginia militia against the French. He grew ill with fever and died in May 1754. Lieutenant Colonel George Washington was named his successor. It was Washington's leadership during this campaign that made his name well known in the Colonies.¹²⁵

THE MASON-DIXON LINE

The Mason-Dixon Line became the boundary representing the division between the Blue and the Gray armies during the Civil War. Because it is the east-west line separating Maryland and Pennsylvania, with a part extending south and east to divide Maryland and Delaware, it is unclear why it was given this place in history, for all three States fought on the Union side.¹¹⁶

The Conflict

Its real place in history goes back much further. In the middle of the 17th century, the rich land of the peninsula between the Chesapeake and Delaware Bays was claimed by both the Calvert family of Maryland and the Government of the Netherlands. When the Dutch were compelled to leave, the dispute was carried on by William Penn. The charters of Penn and Lord Baltimore were open to interpretation because of the vagueness of the documents. This caused quarrels so bitter that the disagreement continued for decades.

The Decision

After years of dispute, a compromise decision by England's Court of Chancery awarded Maryland most of the peninsula. Pennsylvania was to keep the northeastern part, which later became Delaware. The agreement was signed and the work of marking the boundaries was begun by local surveyors in 1760.¹¹⁶

Although the entire episode lasted for more than a hundred years, Penn and Lord Baltimore were suddenly anxious to settle it. When the work did not go quickly enough to suit them, they decided to hire Charles Mason and Jeremiah Dixon to get on with it.²⁹

Mason and Dixon

Mason was 35 years old and held the post of assistant astronomer at Greenwich Observatory in England. Dixon, an astronomer, mathematician, and surveyor, was 30.¹¹⁶ The two men reached Philadelphia in the middle of November 1763 and met with the commissioners of Maryland and Pennsylvania.²⁹

In checking the work already completed, they found it accurate, so in January 1764, they established their headquarters at the Harlan Farm. When the weather improved in the spring, the

surveyors went south from the Harlan Farm along a meridian. Distance measurements were taken as they went along, by chain on level ground and by levels on slopes. They set a post in a field on the farm of Alexander Bryan and marked it "West." It marked the latitude 15 miles south of the south point of Philadelphia. That post was the reference point for the parallel of latitude separating Pennsylvania from Maryland.²⁹

The large survey party set heavy boundary markers at 5-mile intervals. These stones had the Penn coat of arms on one side and the Calvert coat of arms on the other. Smaller stones, marked "P" on one side and "M" on the opposite side, were also set along the line.¹¹⁶ The West Line, as Mason and Dixon called the parallel between Pennsylvania and Maryland, extended from Delaware to the summit of the Allegheny Mountains by the time that the winter of 1766-67 grew cold.²⁹

There was only Indian country west of the Alleghenies. Thus, the following spring, the surveyors had to wait until an escort could be obtained from the Indians of the Six Nations to safely carry on their work. All that spring and summer they continued the survey. By the end of September, the West Line reached the Monongahela River.

Because the Shawnee and Delaware Indians held the land beyond the Monongahela, 26 of Mason and Dixon's men quit the day the surveyors crossed the river. Nonetheless, the surveyors went on until they had crossed a "war path" and reached the top of a great dividing ridge. The termination point was noted in Mason's diary on October 18, 1767: "See on top of very lofty ridge . . . at 233 miles 17 chains 48 links from the Post marked West in Mr. Bryan's field, we set up a Post marked W on the West side and heaped around it earth and stone. . . ."²⁹ Mason and his quiet Quaker co-worker Dixon handed the completed boundary map to the commissioners on January 29, 1768.

The Result

The survey project had lasted 4 years and was the largest surveying accomplishment in Colonial America. The Mason-Dixon Line is probably the best known boundary in this country, even if for the wrong reason. The survey cost just \$75,000 and was amazingly accurate. An elaborate resurvey just a few years ago showed a difference in latitude of only 2.3 seconds.¹¹⁶

THE BEGINNING OF THE RECTANGULAR SURVEYS

THE TRANSITION

Some of the early American surveyors do not really fit into either the colonial period or the period following the Revolutionary War. The Rittenhouse brothers, for example, were surveyors during both times.

The Rittenhouse Brothers

To David and Benjamin Rittenhouse must go a large share of the credit for elevating the colonial art of surveying to the far more scientific art it became as the United States emerged as a nation.¹²⁶

David Rittenhouse was born at Paper Mill Run, near Germantown outside Philadelphia, in April 1732.²⁹ Pictures of him, such as the portrait by Charles Willson Peale, show him as an adult with long hair, a thoughtful face, deep-set eyes, and wearing the garb of an 18th-century Philadelphia gentleman. In his earlier years, however, he was an obscure young country Quaker. He grew up on his father's farm and became a farmer himself. Later, he made clocks and surveying instruments that he used in his jobs as a local surveyor. David Rittenhouse taught himself how to do these useful things; he had always been a brilliant and curious-minded person who, in spite of the limited schooling available to Pennsylvania farm boys of his time, mastered astronomy, mathematics, and Newton's "Principia." Rittenhouse was the designer and maker of the first magnetic declination arc for a surveyor's compass, and he was the first American to put a spider web, for cross hairs, at the focus of a telescope. He calculated the transit of Venus in 1769 and observed it with instruments he had designed and built. When his observations were reported, David Rittenhouse became an internationally famous astronomer. Soon he moved to Philadelphia.

His first surveying job of any note was a boundary survey for William Penn. He laid out the 12-mile radius around Newcastle, Delaware, which formed the part of the boundary that Mason and Dixon found so accurate that they incorporated it into their own survey.²⁹ This work was done with instruments Rittenhouse had made for himself, several years before he achieved a reputation.⁶ Over a period of years, David Rittenhouse surveyed

boundaries for more than half of the Thirteen Original States. His younger brother Benjamin was also a surveyor—a very fine one. Both David and Benjamin were known for making the finest of surveying instruments.¹²⁶

In 1796, by order of Congress, Benjamin Rittenhouse made a surveyor's chain. Afterward, this chain was used as the standard of the United States Land Office.²⁹ The respect accorded the Rittenhouse brothers was evidenced by the 1815 "Instructions for Deputy Surveyors," issued by Surveyor General Edward Tiffin. These instructions required both "a good compass of Rittenhouse construction," and the adjustment "by the standard chain," of "a two pole chain of 50 links." Several of the surveying instruments made by the Rittenhouse brothers today are part of valuable museum collections. Among them are two surveyor's compasses made for George Washington.

In 1792, Washington appointed David Rittenhouse as first director of the Mint. Although David Rittenhouse died in 1796, streets, a city square, a social club, parks, a school, and a scientific body all bear his name, and the clocks made by him probably are still keeping accurate time.

Andrew Porter

Andrew Porter, a soldier in the Revolutionary Army, was also a surveyor noted for his precise and excellent work. Both he and David Rittenhouse served as commissioners on the survey of the Virginia-Pennsylvania boundary in 1784-85. In 1800, Andrew Porter was sent to do the survey to settle the Wyoming Valley conflict. He became the surveyor general of Pennsylvania 9 years later.¹²⁶

Robert Erskine

Robert Erskine was born in Scotland and educated there as a surveyor and engineer. He lived in England until about 1771. Then Erskine was made manager of the holdings of the American Iron Company in the northern part of New Jersey. He was about 36 years old when he arrived in America.

A few years later when the 13 Colonies declared their independence from England, Erskine not only

remained in America, he joined the militia. When George Washington heard about Erskine's surveying background, he asked him to serve as geographer of the Continental Army. Erskine accepted the job, subsequently surveying and making topographic maps of the Hudson-Highlands region. These maps were used in the successful American campaign to keep New England from being cut off from the other Colonies and to defend the area and keep the Americans in control. Unfortunately, Robert Erskine did not live to see the new republic established that he had helped to bring into being.

Simeon De Witt

In 1778 General James Clinton recommended his nephew, Simeon De Witt, to George Washington because of the young man's exceptional ability as a surveyor and cartographer. De Witt soon became the assistant to Washington's chief geographer, Colonel Robert Erskine, whom he succeeded in 1780. De Witt was attached to Washington's headquarters and served in the campaigns that led to the surrender of Cornwallis at Yorktown in 1781.

In May 1784, De Witt was named surveyor general of New York—a position he held for the following 50 years.

LAND BOUNTIES

About 1 month after the Declaration of Independence was signed, the Continental Congress offered deserters from the British Army, including the Hessian mercenaries, American citizenship and 50 acres of public land. A little over a month after that, an act was passed that promised land bounties for naval and military services during the Revolutionary War. Though there was no "Public Domain" and the very existence of the United States was still at issue when the bounties were offered, land warrants were later issued to veterans. More than 2.5 million acres of public land in the old Northwest Territory (Ohio) was reserved as a "military district."¹

STATE LAND CLAIMS

The Thirteen Original States, including land that is now the States of Maine, Vermont, Tennessee, West Virginia, and Kentucky, were never a part of the Public Domain of the United States. Kentucky and Tennessee were formed out of territory once claimed by Virginia and North Carolina, respec-

tively. Maine was part of Massachusetts until 1820, and Vermont was the subject of conflicting claims of its neighboring States until it became a State in 1791.³⁴ West Virginia was separated from Virginia and became a State in 1863, by act of Congress. All of these States kept title to the unappropriated, vacant lands inside their borders.³⁴

Even before the preliminary peace treaty was signed at the close of the Revolutionary War, the Congress was faced with debts, expenses, conflicting colonial claims to western lands, no money, and the duty of providing a financial policy and a plan for settlement. All of these matters had to be resolved if this new country was to survive.

Seven of the Colonies claimed jurisdiction over portions of the vast, unoccupied, somewhat nebulous area called "the western lands." No one was able to state, with any conviction, just where the colonial boundaries lay. The six Colonies that had no charter claim to this land felt that, as it had been won by common effort, it should be held in common. The new National Government, looking upon the lands as revenue-producing assets, agreed.

STATE CESSIONS

New York unconditionally ceded all of her western land claims to Congress in 1780. Following this, Virginia and Connecticut gave up control over Ohio, but Congress permitted them to retain title to certain areas. Massachusetts preceded Connecticut in giving up her claim. South Carolina relinquished her claims in 1787, North Carolina in 1790. Georgia held out the longest. In reading the conditions of her cession,¹⁹ it is apparent that her inability to cope with the Indians and settle the land without the aid of the Federal Government was largely responsible for Georgia finally granting deed of cession in 1802.

The most complicated of the State claims was disposed of with Virginia's cession. This put the new Government in the awkward position of being much too poor to maintain a capital, but in charge of a vast Public Domain. Congress had agreed that the land should be disposed of for the common benefit of the United States.⁹ Benefit could be derived in either of two ways: (1) the land—as much of it as possible—could be sold for the highest possible price; or (2) it could be surveyed, and pioneers could be encouraged to buy and settle the land, making it possible to hold it against foreign claims and Indians.

JEFFERSON'S REPORT

This was the situation in the spring of 1784, when the Continental Congress appointed a committee to develop a plan for locating and selling the western lands. Thomas Jefferson was the chairman of the committee, and the report delivered to Congress that year is in his handwriting.²⁸

Nearly a year went by before anything more was done. Jefferson's report was read and reread. Another committee was appointed, this time with a member from each State. Jefferson had gone to Europe, so William Grayson took his place as the representative from Virginia. This committee amended the first report; notably, township size was reduced from 10 miles square to 7 miles square.⁹

Congress, at that point, did some amending of its own. It reduced township size to 6 miles square. The portion of Jefferson's report calling for surveys before sales, and for the lines of these surveys to be run and marked due north and south with other lines crossing these at right angles, was retained.

1785 LAND ORDINANCE

The first land ordinance, the 1785 Land Ordinance, which was approved by the Continental Congress on May 20, incorporated these provisions. It also included the remarkable provision that, in each township, section 16 would be set aside for the maintenance of public schools. Under the terms of this ordinance, the plats of the townships were to be subdivided into lots 1 mile square "in the same direction as the external lines, and numbered from 1 to 36; always beginning the succeeding range of lots with the number next to that with which the preceding one concluded. . . ."

In the surveys executed under the 1785 Land Ordinance, and in some other areas in Ohio, sections are numbered from 1 to 36, with section 1 in the southeast corner of each township. In these areas, the numbers run from south to north in each range of sections. In 1796, the system of numbering sections was changed to the system now used, with section number 1 in the northeast corner of the township.

The Canadian system of land subdivision is in some ways patterned upon that of the United States, but section number 1 is in the southeast corner of their townships.¹¹ Both American and Canadian section numbers run in opposite direc-

The chain is the unit of linear measurement for the survey of the public lands as prescribed by law. All returns of measurement in the rectangular system are made in the true horizontal distance in links, chains, and miles. The only exceptions to this rule are special requirements for measurement in feet in mineral surveys and townsite surveys.

Linear Measurement

1 Chain = 100 links or 66 feet

1 Mile = 80 chains or 5,280 feet

Area Measurement

1 Acre = 10 square chains or
43,560 square feet

1 Square Mile = 640 acres

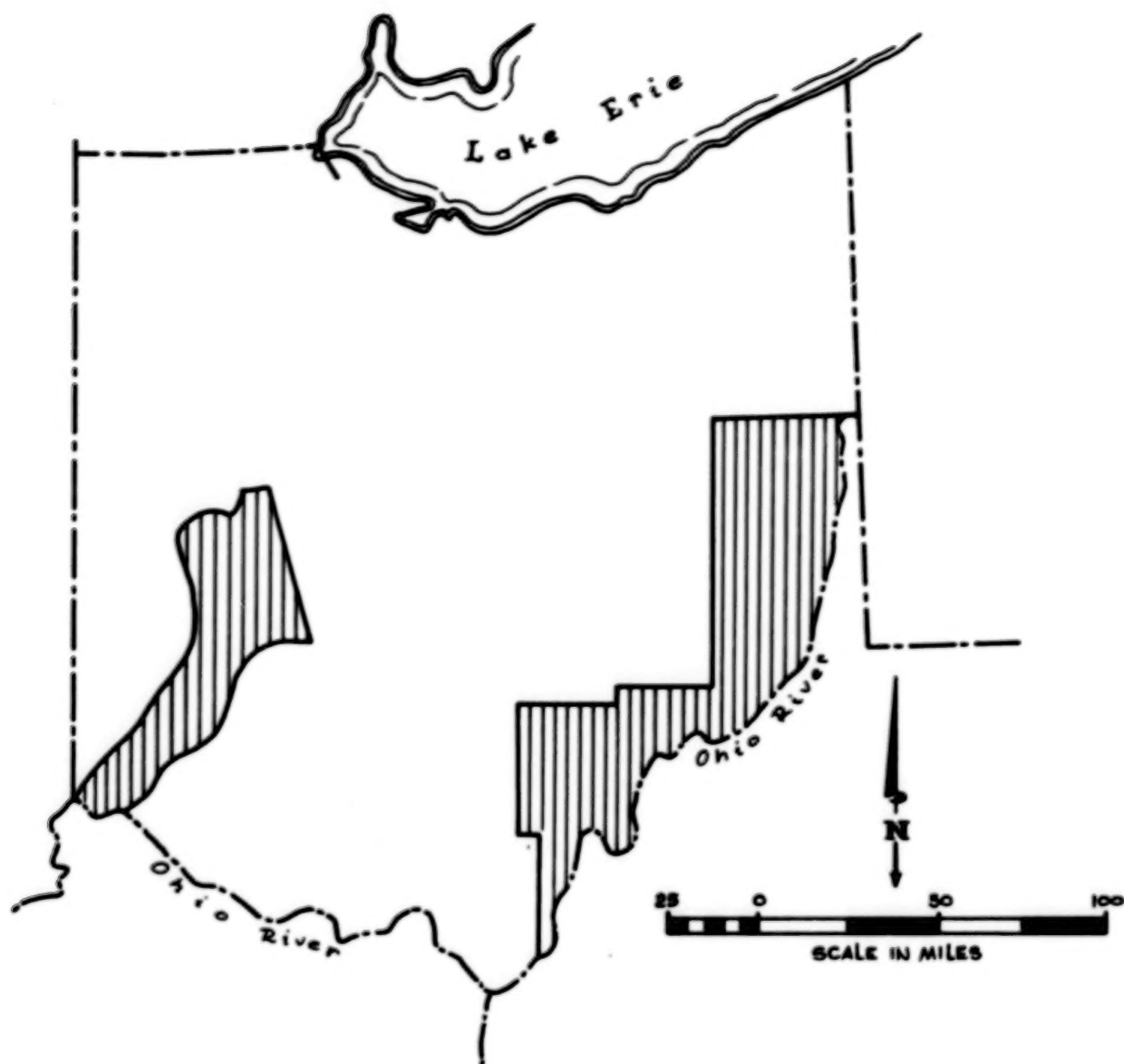
tions in alternate lines. The Greeks have a word—boustrophedonic—for this style of writing. Its literal translation is "turning like oxen in plowing."

THE GEOGRAPHER

Under the terms of the 1785 Land Ordinance, Congress was to appoint surveyors, one from each State, to serve under the direction of the geographer of the United States. The geographer was empowered to give oaths to the surveyors appointed to serve under his instructions. They were to swear to do their duty faithfully. The chainmen on the survey crews took a similar oath.

Under the 1785 Ordinance the surveyors were instructed to measure their lines with a chain, mark them "with chaps on the trees," describe them exactly upon a plat upon which they were to note "at their proper distances, all mines, salt springs, salt licks, mill seats, that shall come to his knowledge; and all water courses, mountains, and other remarkable and permanent things over or near which lines shall pass, and also the quality of the land."

Thomas Hutchins, named as geographer of the United States in July 1781, was chosen to direct the surveys under the Land Ordinance of 1785. Hutchins was born in Monmouth County, New Jersey. When he was little more than a boy, he went



**Areas in Ohio where "Lots" were numbered
in accordance with the Ordinance of 1785 .**

to the frontier—the "western country," serving at times with the Pennsylvania Colonial Troops. It was during these years that he acquired an education in surveying and engineering.

Hutchins was Colonel Henry Bouquet's assistant in 1764, when Bouquet directed the course of a military expedition against the Indians. An account of the conflict, the "Historical Account of Bouquet's Expedition Against the Ohio Indians in 1764," contains a plan for frontier settlement. The

plan very closely resembles the system of land subdivision adopted by the United States. Unfortunately, no author is given credit for the plan, as it is not in the main text of the account.¹¹

Some authorities give Bouquet credit for the plan. He was a Swiss who had served in Holland and in Sardinia. Because there was, during the 17th century, a limited system of rectangular survey in Holland,³³ this is held as evidence that he was the author.³⁰ Other authorities are equally certain that

THE RECTANGULAR SURVEY SYSTEM

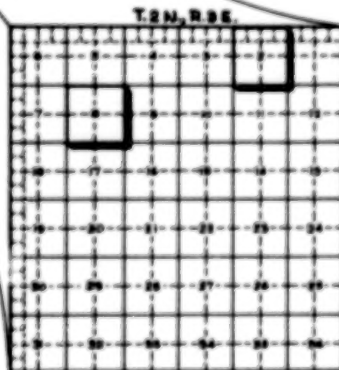
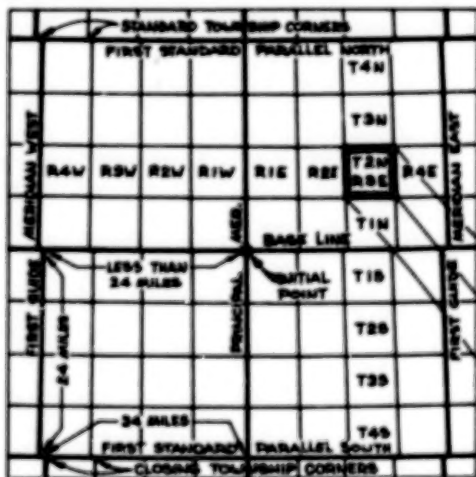
The U.S. rectangular system of surveys is a marvel of simplicity. Because of the system and the cadastral surveyors who transferred it from a plan on paper to regular lines upon the land, the swift and orderly settlement of a vast public domain became a reality.

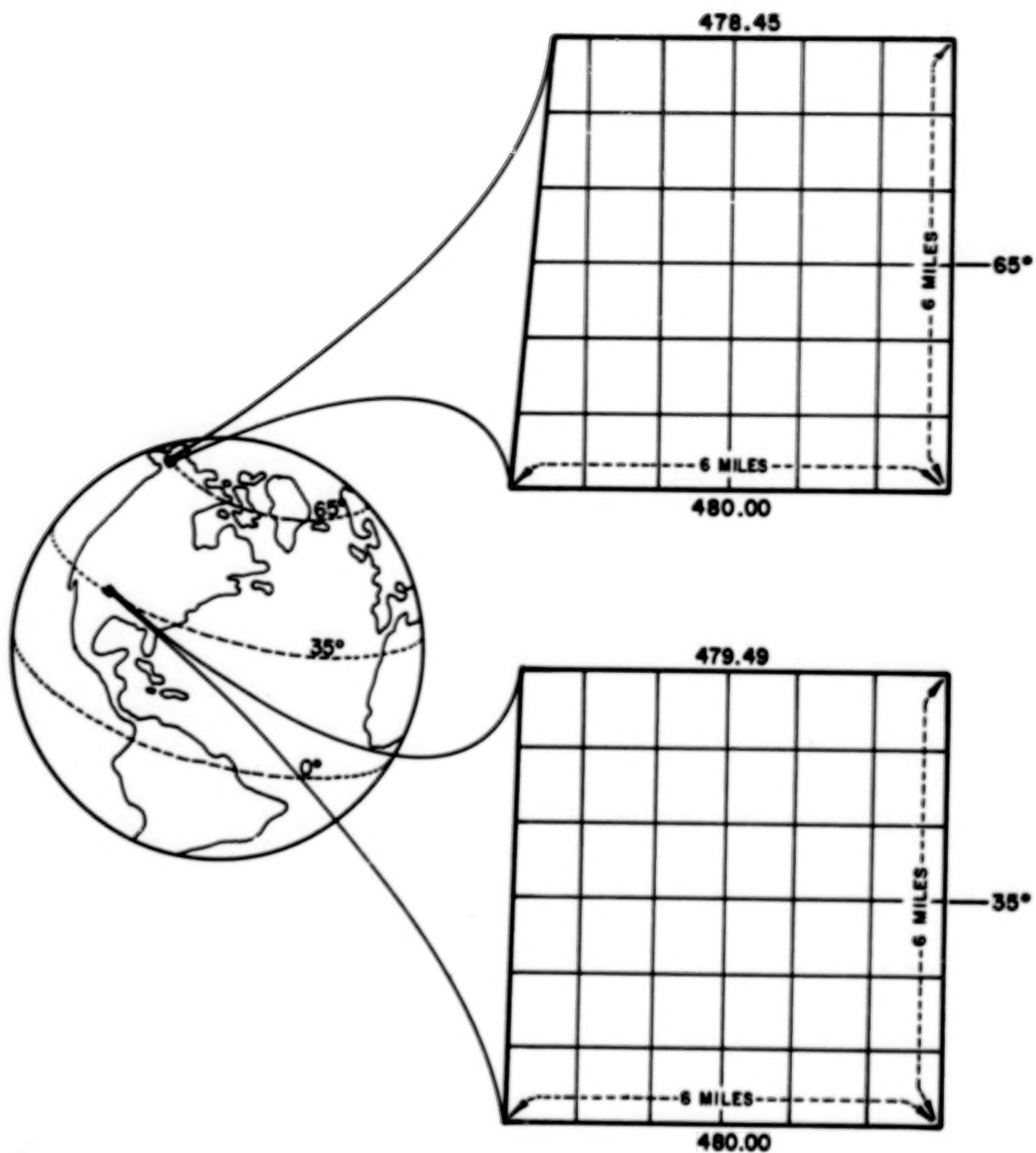
Separate large pieces of the Public Domain are, in themselves, huge survey areas. There are 31 principal meridians and base lines in the contiguous United States and 5 in Alaska. At the intersection of these two lines is the initial point of each of the survey areas. Some of the principal meridians are numbered and the rest have proper names. The numbered ones go only to the Sixth Principal Meridian. Most of the other (named) meridians give a clue as to the area they govern: for example, the Boise Meridian, the New Mexico Principal Meridian, and the Humboldt Meridian. Townships are numbered north or south of the base line. A line or column of townships is called a range, and they are numbered east or west of the principal meridian.

At the beginning of the use of the rectangular system, no provision was made for the convergence of meridians or the limitation of accumulated error. At a later time standard parallels and guide meridians were included in the plan. Between the standard parallels the excess or deficiency of measurement caused by convergency and accumulated error in each township is placed in the sections lying against the north and west township boundaries. Each of the other sections theoretically contains 360 acres.

Each 36-square-mile township is divided into 36 one-square-mile sections numbered from 1 to 36. The section numbers run in opposite directions in alternate lines, beginning with section number 1 in the northeast corner of the township. These numbered sections may be further divided into aliquot parts, and thus described and identified. The southeast quarter of the southeast quarter of the southeast quarter of section 5, Township 2 North, Range 3 West, of the Boise Meridian, describes just one parcel of land. The description even tells the inflated how many acres are being described. The familiar BLM abbreviation for this particular 10 acres is SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$, sec. 5, T. 2 N., R. 3 W., Boise Mer., Idaho.

Land, and the hope of sharing in its ownership, provided an attraction strong enough to bring millions of people to this country. The straightforward system of cadastral surveying and land identification added to the attraction. By its adoption the United States, for the most part, avoided the disputes, litigation, and bloodshed inherent in a metes and bounds system.





EFFECT OF CONVERGENCY AT VARIOUS LATITUDES

Thomas Hutchins was the originator of the plan.¹¹ They cite the fact that he was in the habit of keeping records of his travels and his work, and that he had been employed to lay out plans for a number of military posts. Military establishments had long been laid out in a rectangular manner.

Hutchins served as a British officer at Fort Pitt. He made exploratory journeys from there north to Lake Erie and overland to Lake Michigan and the upper Wabash Valley. His expeditions also took him down the Ohio River and to the Mississippi. Hutchins compiled a general map of the West as a result of these travels, which established him as a authority on the area.

By the time the Revolutionary War was declared, Hutchins had attained the rank of captain of the 60th Foot or Royal American Regiment of the British Army. He was in London at the beginning of the war, and the British, quite naturally, planned to put his experience to their use. After all, he was the British Army's leading expert on the American frontier.

The British, however, had forgotten one very important fact: Hutchins was an American. Because he refused to fight against other Americans, he was imprisoned in August 1779. When he was released in February 1780, Hutchins contacted Benjamin Franklin, who was in France at the time. Through Franklin, arrangements were made for Hutchins to travel to South Carolina where he joined the American forces under Nathanael Greene. In May 1781, Congress appointed him geographer of the southern army and the following July he was given the title of geographer of the United States.

Two years later, Hutchins was commissioned by the State of Pennsylvania to extend the survey from the western end of the Mason-Dixon Line to the point that was to be the southwest corner of the State, and from there to survey the west boundary of Pennsylvania north to the Ohio River. The line was to be the boundary between Pennsylvania and Virginia, so Virginia also appointed surveyors Andrew Ellicott and Joseph Neville.⁸² There were, in fact, three men from each State on this particular

survey. The two others from Pennsylvania were David Rittenhouse and Andrew Porter.¹³⁰

Point of Beginning

The survey marking the southern boundary of Pennsylvania was completed in 1784. Before the survey of the western boundary began the following year, Hutchins was told his services as geographer would be needed. Thus, the 1785 Land Ordinance was passed. It called for the survey of the public lands to begin ". . . on the River Ohio at a point that should be found to be due north from the western terminus of a line which has been run as the southern boundary of the State of Pennsylvania."

Four boundary surveyors—David Rittenhouse and Andrew Porter, who had been commissioned by Pennsylvania, and Andrew Ellicott and Joseph Neville, who surveyed for Virginia—established this point on August 20, 1785.²⁸ Following their arrival on the south bank of the Ohio, near the mouth of Mill Creek, Andrew Porter noted the event:¹³⁰

This morning continued the Vista over the hill on the south side of the River and set a stake on it by the signals, about two miles in front of the Instrument, brought the Instrument forward and fixed it on a high post, opened the Vista down to the River, and set a stake on the flat, the north side of the River.

The Geographer's Line

Hutchins, as geographer of the United States, was to "personally attend to the running of" a line westward from the newly established "point of beginning." This line extends the width of the Seven Ranges—42 miles—and is known as the Geographer's Line. Later surveys show it to be about 1,500 feet south of its intended position at the western end.¹³⁰ Even so, it was the first line surveyed under the rectangular system of the United States. It was the start of the most magnificent cadastral survey project in history.

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THE ELLICOTTS AND BENJAMIN BANNEKER

THE CAPITAL

On the last day of April 1789, George Washington became President of the United States under the new constitution. This was just 2 days after the death of Thomas Hutchins, the man responsible for the survey that had undoubtedly been the most significant project under the Confederation. Now, however, there was another project to think about. This Nation was, at last, to have a Constitutional Capital—the City of Washington.

Jefferson and Hamilton made a political agreement to move the capital to Philadelphia from New York in 1790, where it was to remain for 10 years. Following that, the capital was to be situated in the 10-mile-square tract of Federal land near the place where the Anacostia River joins the Potomac River.

THE ELLICOTTS

In February 1791, Secretary of State Jefferson, at President Washington's suggestion, asked Andrew Ellicott to go "by the first stage to the Federal Territory on the Potomac for the purpose of making a survey of it."¹²⁴ It is not surprising that Andrew Ellicott was the surveyor designated to do this important work. At the time he was perhaps the most highly regarded surveyor in the United States. Moreover, he and his brothers had lived not far from the chosen site for almost 20 years. In 1770, Ellicott's father and two uncles had settled on the Patapsco River, some 10 miles east of Baltimore, and had built Ellicott's Mills. The town that grew up around that mill is today called Ellicott City.

Andrew was only 16 years old, Joseph, Jr., was 10, and Benjamin just 5 when they left Bucks County, Pennsylvania, where they were born. These Quaker boys were exceptionally good at mathematics, and all three of them became surveyors. They knew and admired the Rittenhouse brothers, and Andrew had studied under a highly respected Irish mathematics professor, Robert Patterson, in Pennsylvania.¹²⁷ In spite of a boyhood filled with gentle Quaker teaching, tall, large-framed Andrew joined the Elk Ridge Battalion of the militia and fought with it through the Revolutionary War. He attained the rank of major, a title by which he was recognized the rest of his life.

Soon after the war, he was appointed by Virginia as a member of the survey to continue the westward Mason-Dixon Line, survey of which had been stopped by unfriendly Indians in 1767. In the following years he surveyed other boundary lines,⁸ including the meridian northward from the point of beginning on the north bank of the Ohio River. This Ohio-Pennsylvania boundary is called Ellicott's Line.³⁰ The line along the 31st parallel, which will be discussed later, is called Ellicott's Line of Demarcation.

As Major Ellicott worked on the survey of the Federal Territory, Jefferson contacted the tempestuous, fiery-tempered Frenchman and American Revolutionary War veteran, Pierre Charles L'Enfant, "... to have drawings of the particular grounds most likely to be approved for the site of the Federal Town and buildings ... connecting the whole with certain fixed points on the map Mr. Ellicott is preparing."¹²⁴

BENJAMIN BANNEKER

Benjamin Banneker, a brilliant surveyor-astronomer, was also hired to work on the preliminary survey of the capital site. Banneker, a black man, was a friend of the Ellicott brothers and their cousin, George Ellicott. His mother Mary was the oldest daughter of a white indentured servant named Molly Welsh and a Negro slave named Banneker (or Bannaker) whom she purchased, freed, and married. Banneker's father Robert was from Guinea, and he, too, had been a slave.⁵ Benjamin Banneker was born free, because the law said he was to follow the status of his mulatto mother instead of that of his freedman father. Perhaps this law is the reason that Robert had taken Mary's name when they were married.

Even when Benjamin Banneker was very young, people were impressed by his many interests and by the speed and ease with which he learned. For example, he was able to read by the time he was 4 years old.²² When Banneker was 6, probably in the late 1730's, his father bought a large farm about 10 miles from Baltimore, Maryland. Banneker attended the school of a Quaker farmer, along with the other young people in the area. He soon surpassed the other students in mathematics, and amazed those who knew him with his unusual gifts. A trader gave him a watch, and from drawings made from it,

Banneker actually constructed a clock. Its frame and movements were made entirely of wood. It was the first instrument of its type ever made in America.²² Even though his clock was the wonder of the community, Banneker remained a farmer until he was well past 50 years old.⁵

When the Ellicotts moved to Maryland, Banneker helped in the construction of their mills. The wonderful wooden clock came to their attention, and they were pleased to help Banneker acquire the knowledge for which he hungered. The Ellicotts loaned him books, tools, and instruments.⁶ More than that, they gave him their friendship. All of them, but George perhaps most of all, encouraged Banneker to pursue his studies.

Banneker learned surveying and developed a dedicated interest in astronomy. He spent many nights studying the stars and their courses, and he became adept with his borrowed instruments. He learned to calculate ephemerides and finished computing data for his first almanac in the spring of 1790. Banneker, then nearly 60 years old, was disappointed because it was not published immediately. Due to the Ellicotts' interest, the almanac came to the attention of the Pennsylvania Society for the Abolition of Slavery, and, eventually this led to its publication.⁵

According to an account by Silvio A. Bedini in "Early American Scientific Instruments and Their Makers,"⁶ Benjamin Banneker, while assisting Ellicott in surveying the City of Washington, "completed his almanac and gave it to George Ellicott, Andrew's cousin, as a subject of possible interest. Apparently George Ellicott turned it over to the Honorable James McHenry of Baltimore, who in turned [sic] submitted it to the firm of Goddard & Angell, who published it. . . ."

According to another account, also by Silvio A. Bedini, titled "Benjamin Banneker and the Survey of the District of Columbia, 1791,"⁵ after Banneker completed his work as scientific assistant to Major Ellicott during the preliminary survey of the Federal Territory, he returned home. He then set to work finishing his calculations for 1792. Banneker had begun collecting data for this almanac while he was still working on the survey of the City of Washington, but he finished it in Baltimore County. In June 1791, Elias Ellicott, George's brother, sent word to James Pemberton in Philadelphia that Banneker's ephemeris was ready to be printed.

Banneker's place in history is firmly secured by the fact that he made the observations and calculations needed in the survey of the 10-mile square in which our Nation's capital is situated. Adding to his stature is the fact that six of the

ephemerides calculated by this largely self-taught black farmer were published, over a period of years, in nearly 30 different editions.⁵

L'ENFANT'S PLAN

The L'Enfant-Ellicott team made rapid headway on the survey and plans for the capital. Joseph and Benjamin Ellicott joined their brother on the project in late spring in 1791. Under L'Enfant, broad avenues took graceful shape, and the plans began to show a more and more beautiful city. When L'Enfant submitted his plans for approval by Congress, however, they were, mainly because of his demands, refused. L'Enfant then resigned and would not allow the plans to be used at all.¹²⁴

In March 1792, Andrew Ellicott was placed in charge of finishing the capital survey. He revised and redrew L'Enfant's plan for the city. It was accepted by Congress, and the final minor points of the project were completed by Major Ellicott's assistants.

In 1793, Pennsylvania commissioned Andrew Ellicott, already gray-haired at the age of 39, to locate a road and lay out the towns of Erie, Warren, and Franklin. It was a large and difficult task, but the major finished it by the fall of 1796.⁵ At about this time, Joseph Ellicott was working on surveys for the Holland Land Company in the western part of New York. These surveys were of subsequent value when people started talking about building the Erie Canal. Joseph also laid out a city he called New Amsterdam, which is now Buffalo, New York.¹²⁷

ELLICOTT'S LINE OF DEMARCATION

President George Washington personally appointed Major Ellicott to work with the Spanish surveyors in running and marking the boundary line between the Mississippi Territory and Spanish Florida, which was determined by the treaty dated October 27, 1795.⁶ The boundary was to be latitude 31° N. A marker was set where the 31st parallel of north latitude intersected the Mississippi River, in what is now Mobile County, Alabama.

Ellicott's Stone, as it is called, is sandstone and measures some 2 feet wide. It is about 8 inches thick and stands 2 feet above the ground. "U.S. Lat. 31, 1799" is cut deeply into its north side; the south side reads, "Domino de S.M. Carlos IV, Lat. 31, 1799."¹¹⁵ Even though the stone was placed as a part of a boundary survey, it was also the basis for many other surveys in the southern part of Alabama. Some of the distance measurements were, later, found long,⁷⁷ but as shown by the U.S.

Coast and Geodetic Survey marker set in Ellicott's Stone at a later time, the survey was reasonably accurate. The U.S. Coast and Geodetic Survey values on it read: Lat. $30^{\circ} 59' 51.463''$ and Long. $88^{\circ} 01' 21.076''$.¹¹⁵

OTHER BOUNDARY SURVEYS

The Georgia-North Carolina boundary was a controversial one. The dispute over it was settled in 1810, when Major Ellicott determined the 35th degree of north latitude.²⁹ Georgia had hired him to do the survey, and, using either Rittenhouse instruments or those made by himself or his

brothers, he did his usual fine and accurate job, with the result that his survey added land to North Carolina. This was not at all the information that Georgia wanted, so, consequently, Ellicott was never paid for his work.¹²⁷

Andrew Ellicott's last surveying project was the long-disputed international boundary along the 45th parallel. In 1817, he was asked to locate a portion of this U.S.-Canadian boundary in accordance with article 5 of the Treaty of Ghent. In order to do so, he was granted leave from the United States Military Academy at West Point to which President Madison had appointed him professor of mathematics in 1815. Major Ellicott held this professorial post until his death in 1820.⁸

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THE PROVING GROUND

LAND SUBDIVISION IN OHIO

Ohio has often—and accurately—been called the proving ground of the rectangular system. The public land surveys there were affected by several different factors, all of which make the relative location of Ohio townships difficult to determine.

First, there were two large tracts of land in Ohio to which the United States had no claim—Virginia's Military Reserve and Connecticut's Western Reserve and Firelands. These two tracts were surveyed according to the laws of the States that claimed them. Two other sizeable tracts of Ohio land were sold to large companies of speculators shortly after the rectangular system was adopted. These tracts were surveyed by the companies that had purchased them, sometimes according to their own rules.

AN IMPERFECTED SYSTEM

Most important, the rectangular system itself had not yet been perfected. No basic framework existed so that the relative location of townships could be ascertained with ease. No plan had been formulated for the eventual expansion of the surveys. Also, there was no provision for eliminating the basic conflict brought about by the law, which called for the surveys to be both rectangular and have sides running in the cardinal directions. This was, obviously, an impossible requirement on a planet where meridians converge as they near the poles. These basic imperfections in the Land Ordinance of 1785 were not resolved when the Land Act of 1796 was passed. In addition, whereas both the Land Ordinance of 1785 and the Land Act of 1796 assumed that townships and ranges would be numbered, neither of them provided a plan for that numbering. For some unknown reason, however, the system of numbering sections adopted under the Ordinance of 1785 was changed by the Land Act of 1796.

SURVEYS WITH NO INITIAL POINT FOR TOWNSHIP IDENTIFICATION

The west boundary of Pennsylvania served as the first reference meridian for the public land surveys and the Ohio River as the base from which townships were numbered. A number of other reference meridians and bases were also used in

Ohio to govern certain areas for the purpose of the disposal of the land. As a result, there are eight public land surveys—seven in Ohio and one in Indiana—that have no initial point as an origin of both township and range numbers.¹³⁷

THE OHIO RIVER SURVEY AREA

The survey of the Seven Ranges began in 1785. There, townships are numbered northward from the Ohio River, and ranges are numbered westward from the Ohio-Pennsylvania boundary. Sections are numbered progressively northward in successive tiers starting at the southeast corner of each township. The lands west of the Seven Ranges, east of the Scioto River, and south of the U.S. Military Tract, were surveyed in a somewhat uncoordinated manner, but nevertheless in more or less the same way as the Seven Ranges; that is, townships are numbered northward from the Ohio River and ranges are numbered westward from the west boundary of Pennsylvania in continuation of the numbering within the Seven Ranges. Because this area was surveyed in 1798 and 1799, however, sections are numbered according to the plan set

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

TOWNSHIP SUBDIVISION AND CORNERS MONUMENTED UNDER THE LAND ACT OF 1796

Numbering of Sections

36	30	24	18	12	6
35	29	23	17	11	5
34	28	22	16	10	4
33	27	21	15	9	3
32	26	20	14	8	2
31	25	19	13	7	1

System used under
Ordinance of May 20, 1785

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Act of May 18, 1796

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

System used in Canada's
Dominion, or public, lands.
The dimensions of Canadian
townships usually differ from
those of the United States
due to their provision for
roadways between or within
sections.

forth by the Land Act of 1796. The lands north of the Seven Ranges and the U.S. Military Tract and south of Connecticut's Western Reserve were surveyed during 1799 in the same manner as those west of the Seven Ranges. All of this area, including the Seven Ranges, is called the Ohio River Survey area.

THE U.S. MILITARY SURVEY

Under the provisions of a Congressional act passed on June 1, 1796, the United States Military Tract was surveyed into 5-mile-square townships. The ranges in this survey area are designated by progressive numbers west from the west boundary of the Seven Ranges. Townships are numbered northward from the south boundary of the military tract. According to the terms of the Act of March 1, 1800, 50 quarter townships of land that still remained unclaimed at that time, together with unclaimed fractional quarter townships, were subdivided into lots of 100 acres each and reserved to satisfy military warrants. The remainder of the lands in this survey area was surveyed into sections of 640 acres each and offered for sale on the same basis as other public lands. Each of these townships, however, contains only 25 sections. These sections are numbered according to the present plan.

WEST OF THE GREAT MIAMI RIVER

In 1798, the survey of the public lands lying west of the Great Miami River in Ohio was begun. In it townships are numbered northward from the Great Miami River, and ranges are numbered eastward from the meridian surveyed north from the mouth of the Great Miami, now the Ohio-Indiana boundary. In this area, which is bounded on the north by the Greeneville Treaty Line, sections are numbered according to the revised plan.

OHIO RIVER BASE—INDIANA

The Ohio River Base survey area in Indiana is the only one outside of Ohio that has no initial point as an origin of numbering both townships and ranges. In this area—known as the Gore of Indiana—townships are numbered north from the Ohio River and ranges are numbered west from the Ohio-Indiana boundary and its projection south. The survey of this area was started in 1799 and in it sections are numbered according to the revised plan.

SCIOTO RIVER BASE

The Scioto River Base survey in Ohio was also surveyed in 1799. Townships in this area are numbered north from the Scioto River and ranges are numbered west from west boundary of Pennsylvania.

MUSKINGUM RIVER SURVEY

The Muskingum River Survey area was surveyed in 1800. Its range is numbered 10 and its townships are numbered 1 and 2.

BETWEEN THE MIAMI RIVERS, NORTH OF SYMMES PURCHASE

The public land area known as Between the Miami Rivers, north of Symmes Purchase, was surveyed beginning in 1802 in continuation of the plan adopted by Symmes in the survey of his tract. In this area, contrary to all other public land surveys, townships are numbered east from the Great Miami River and ranges are numbered north from the Ohio River, in continuation of Symmes' numbering. The sections are numbered according to the same plan as those in the Seven Ranges.

TWELVE-MILE SQUARE RESERVE

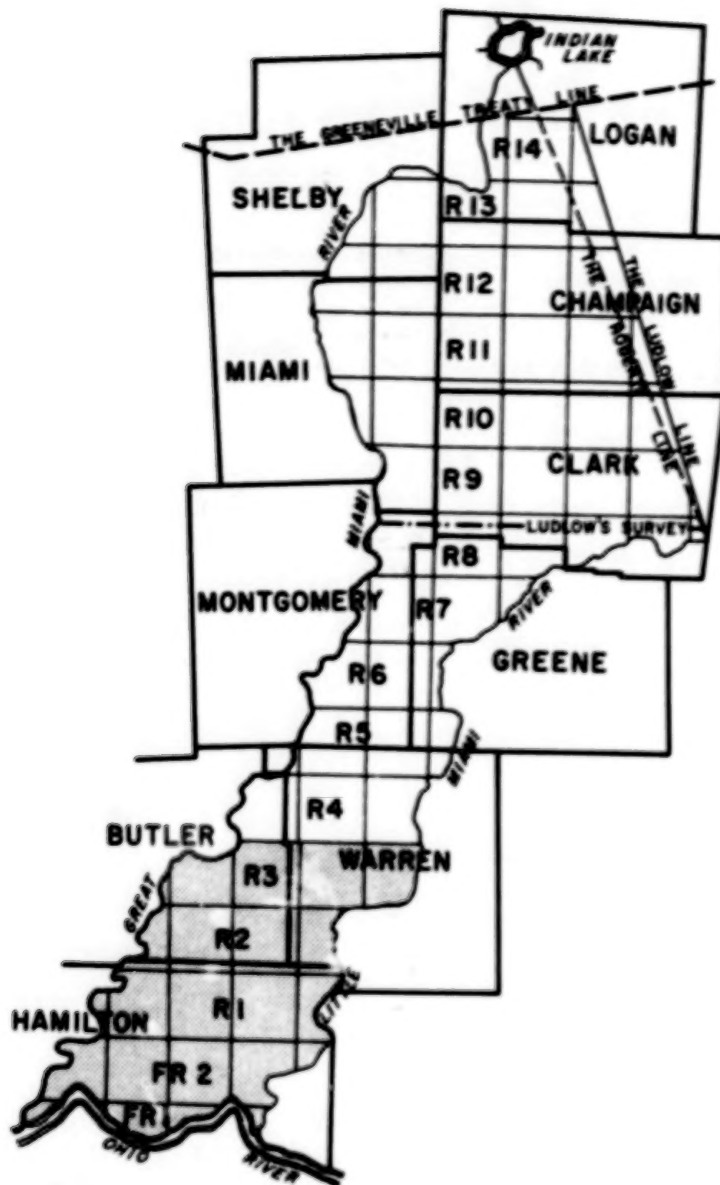
The last public land survey area to have no initial point as a basis for township identification was surveyed in 1805. It is the Twelve-Mile-Square Reserve and it has no range number. Its townships are simply numbered 1 through 4.¹³⁷

NORTHWESTERN OHIO

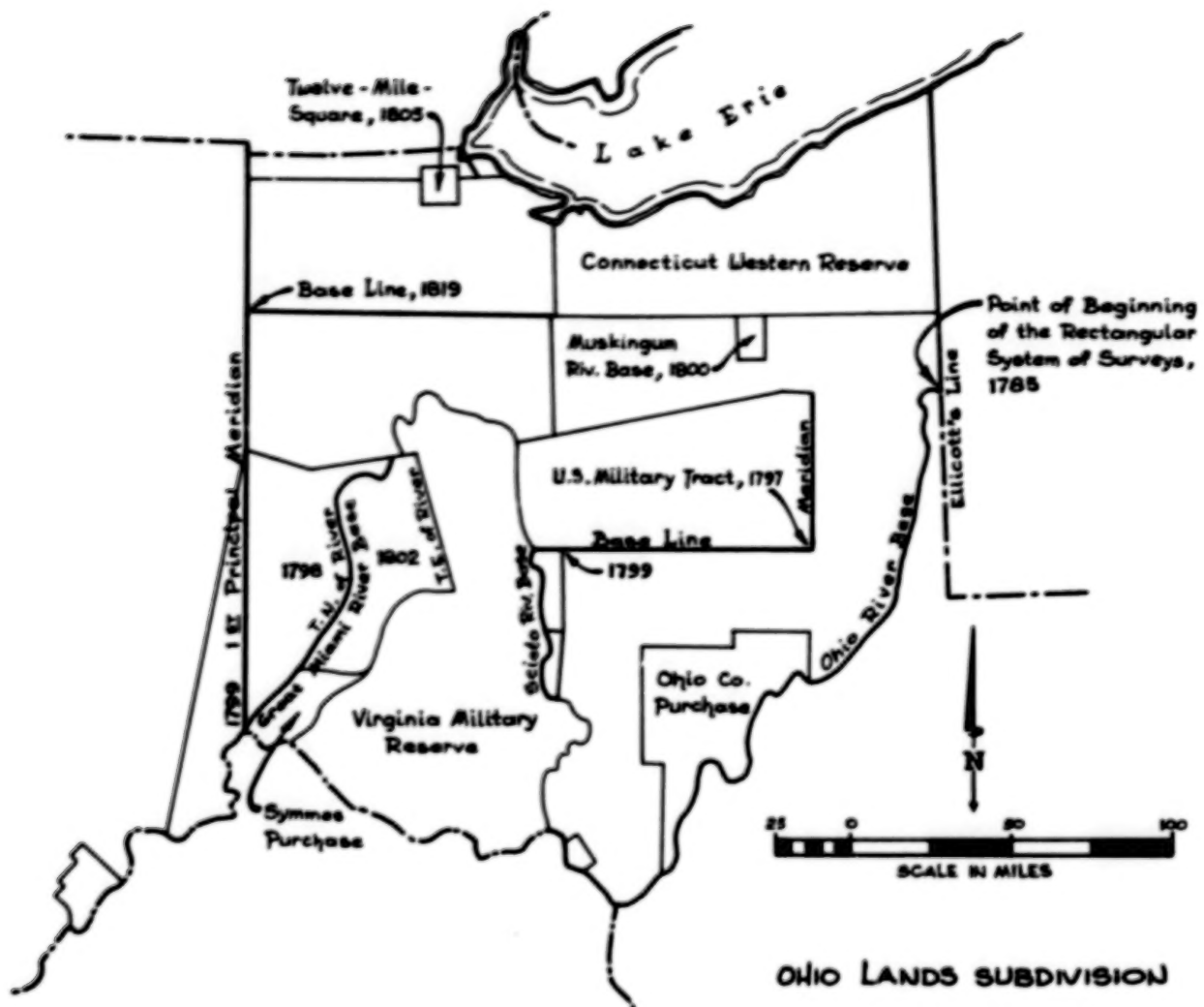
The intersection of a base line with the First Principal Meridian was adopted in 1819 as the initial point for public land surveys in northwestern Ohio. Public land surveys in this part of Ohio were executed along the lines of the present plan.

CONFLICT WITH MICHIGAN

As if all this were not enough, Michigan and Ohio could not agree on the position of their common boundary. The question was not resolved until Michigan was admitted as a State in 1837. Long before that time, the surveys in the southern portion of the area governed by the Michigan Meridian had been executed and extended to the position for the State boundary as claimed by Michigan. When the State boundary was finally established the public land surveys were closed upon that boundary. The lands originally surveyed under the Michigan Meridian and situated south of



The private survey of the Symmes Purchase (shaded area) was the basis of a unique Ohio public land survey. In the "Between the Miami Rivers" survey area, townships are numbered eastward from the Great Miami River and ranges are numbered northward.



the State line continue to be governed by the Michigan Meridian although they are administered within the State of Ohio.¹³⁸

THE SEVEN RANGES

1785

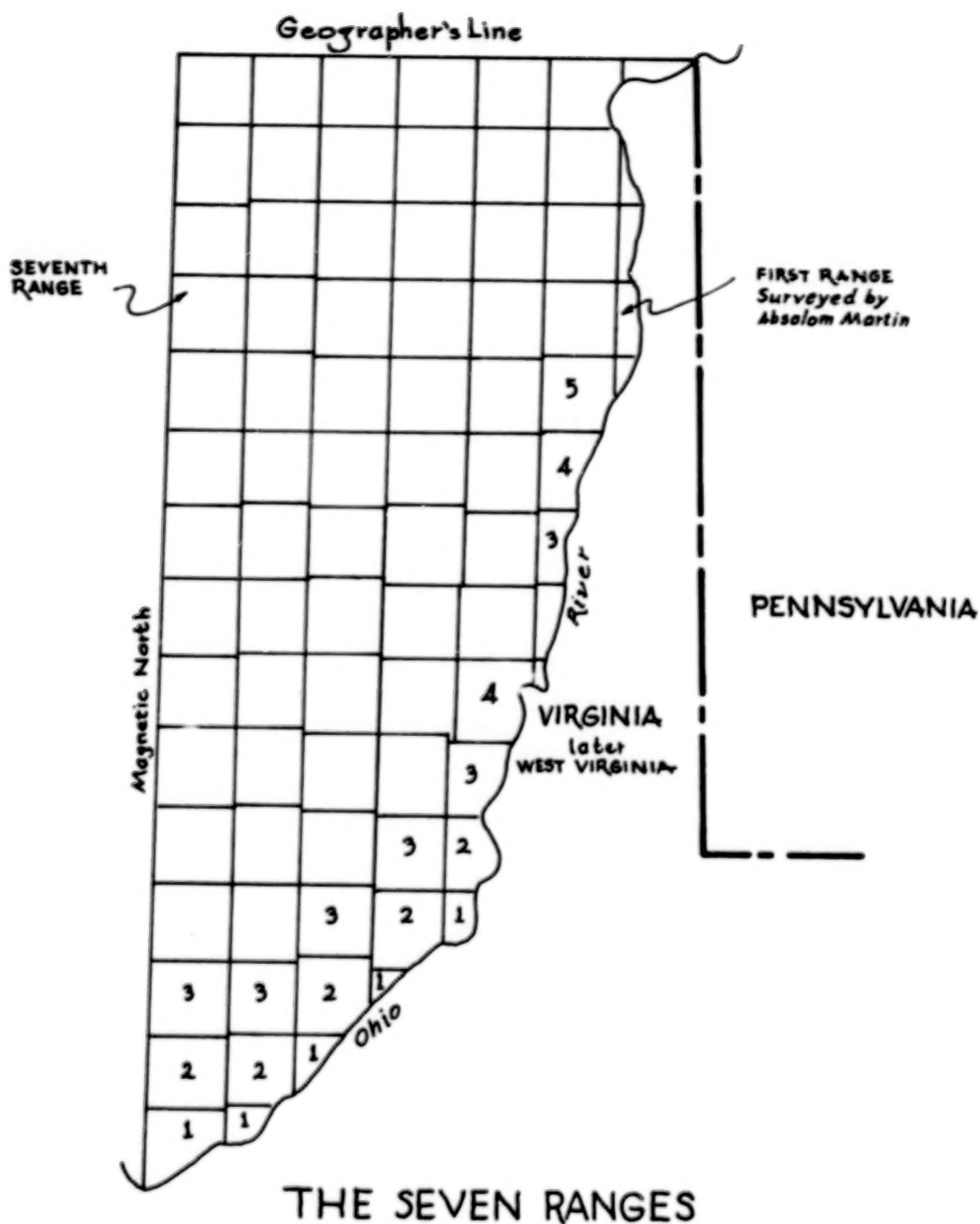
In the summer of 1785 the first United States Government survey party, under the direction of Thomas Hutchins, met at Pittsburgh where teamsters, horses, and supplies had been gathered. Although there were to have been 13 surveyors—one from each State—only 8 actually began the survey. They were Edward Dowse of New Hampshire, Benjamin Tupper of Massachusetts, Isaac Sherman of Connecticut, Absalom Martin of New Jersey, William W. Morris of New York, Alexander Parker of Virginia, James

Simpson of Maryland, and Robert Johnston of Georgia.

Hutchins and the rest of the party moved downstream from Pittsburgh and set up camp at the mouth of Beaver Creek, near the point of beginning.¹³³ On the last day of September, starting at the initial point, Hutchins personally supervised the start of the first east-west line—the Geographer's Line. Yet on October 8, 1785, after surveying just 4 miles of the Geographer's Line, Hutchins stopped work for the season. He reported that the work had been halted due to "disagreeable intelligence concerning the Indians."¹³¹

1786

Apparently the intelligence concerning the Indians was more agreeable by the following spring, because Major Winthrop Sargent tried to



get an appointment as a surveyor at that time. Sargent was from Massachusetts and had been a distinguished artillery officer in the Revolutionary War. He, along with many other soldiers, had suffered financial reverses while he had been in the service of his country. Some of these veterans joined together in organizing the Ohio Company of Associates, which planned settlement in the western country. Sargent was elected secretary of the group.¹⁰²

General Henry Knox, then Secretary of War, was an old army friend of his, so Sargent went to him about securing the appointment. Knox told him that the appointments had been made, but that they might need more surveyors. Knox and Hutchins agreed that Sargent would be a good man to have along. Hutchins had heard that the surveyor for North Carolina might not be able to accept. He advised Sargent to try for the vacancy, should it occur.

By June 11, 1786, Knox was sure there would be at least one vacancy and wrote to Sargent suggesting that a man already in the area would have the best chance of getting the job. Sargent took the hint and started west toward Fort McIntosh. While he was on his way to the fort, he was elected by Congress as the surveyor from New Hampshire, to replace Edward Dowse, who had resigned.

Sargent's Diary

For the next few months, Sargent kept a diary. He began it on June 18, as he left Boston, and he ended it upon his return from the field, just before Christmas 1786. John Mathews, later to become Sargent's assistant, also kept a log. They were unusual in this respect because few of the surveyors there or on later surveys took the time to keep a record other than their field notes.

On his trip west, Sargent stopped in Philadelphia long enough to visit and dine with Benjamin Franklin. Though he enjoyed this social encounter, he did not seem to be too happy with the rest of Pennsylvania. In Pittsburgh, which was then a town of about 80 long huts, he stayed "at Smith's Tavern which tho' as good as any Place is bad enough and very extravagant."

Beyond Pittsburgh, Sargent traveled with Major John F. Hamtramck, commander of Fort McIntosh. The day after their arrival, Sargent crossed the river and reached the surveyor's camp opposite the mouth of Little Beaver Creek,¹⁰² where all of the other surveyors were assembled. They drew lots to see who would survey which range. In August 1786, 6 miles due west of the point of beginning,

Absalom Martin of New Jersey started south on the survey of the first range.¹⁰¹ He had drawn lot number one and thereby gained a small measure of fame. Sargent drew number five.¹⁰²

Danger from Indian attack was discussed, and the other surveyors were not as optimistic as Hutchins. They requested troops to protect them. Hutchins arranged for military escort from Fort Harmer because he did not want another time like his first attempt.

Sargent was detained in camp because his supplies had not arrived on schedule. While he waited, three of his Revolutionary War friends stopped to visit. They were on their way down river to Fort Harmer, but they spent the evening sitting around the campfire talking over old adventures and speculating about the future. One of their topics of conversation was their hope of finding peace and justice in their new homes in the western country and their desire that, in these homes, "the veteran soldier and honest man should find a Retreat from ingratitude. . . ."

These words expressed some of the bitterness Sargent and other Revolutionary War veterans felt because of the reverses they had suffered during the war and the neglect with which they and their problems had been treated in the Eastern States after the war was over.

Because his supplies had not yet arrived and it appeared that there would be several days before work could begin, Sargent went with his friends on their trip to Fort Harmer. They went by river. The weather was fine and the land they saw along their way was rich and level, yet not wet nor too low. Sargent's diary tells that he could picture cattle grazing in the luxuriant meadows. The trees along the banks of the river were majestic oaks and walnuts. Hickory and maple trees of huge proportions were also noted. During the time (July 23 to August 2) that he spent at Fort Harmer, Sargent made several excursions into the surrounding area. His diary indicates his appreciation of the country.

On his trip from Fort Harmer back to his own camp, Sargent noted the farms of several squatters on the north shore of the river. He resented their presence in an area he would have liked for the Ohio Company settlement and referred to them as "lawless banditti." Later, Sargent was to find that this attitude was one the squatters did not find particularly endearing as they considered themselves adventurous pioneers.

Sargent's days of rest, with time for exploring the country, came to an end when the chainmen, packers, and horses reached camp. The pay for the

packers was a "half Joe" each per month and 30 shillings per head for the horses. (A half Joe was a Portuguese gold coin which was equivalent to about \$8.)

The survey work actually began on September 2, 1786. Dense swamps and thick undergrowth made progress slow. In many places the only way to get through was to cut a line every rod of the distance. There were not enough men and their instruments lacked modern refinement. These first surveys did have inaccuracies but, considering the odds the men worked against, they were very well done indeed.

In reaching his own range—the fifth—Sargent spoke of the others. The first range was "tolerably good but a little broken"; the next was "fine lands, by no means high, but level"; for the third, "extreme bad-broken and some very high hills." The fourth range he called "good lands." His range lay beyond these others and was covered with thick underbrush.

At times no more than 2 miles a day could be made with the surveying. For this work the surveyor received, including all expenses, \$2 per mile. When Sargent had run the east-west line of his range, he was asked to run Simpson's on the sixth range. Sargent completed it and returned to work on the fifth range.

About this time a rumor of the presence of a large band of Shawnee Indians was being circulated. The report caused Hutchins and the surveyors with him to return to camp. Sargent did not believe the report; he had not seen any Indians, and even if there were any, he could not see that he should behave any differently than when he was in the army and exposed to danger every day. He and his crew stayed on the job, and he wrote a letter to Hamtramck asking if there were any truth to the whole thing. The last line of the letter tells of his plan to go West until he received an answer. Fortunately the rumor, this time, was false.

Before the end of September, the rumors of Indian hostilities were becoming alarming. Sargent and his crew returned to the camp at the mouth of Little Beaver Creek. Hutchins called all the men together there to consult with them about the work. Sargent was of the opinion that, since they had not been attacked, they should not have stopped their work. He was certain it would be taken as a sign of weakness by the Indians.

Hutchins told the assembled survey crews that he thought four ranges should be completed. Work beyond that range he left up to a vote of the surveyors. They voted that it was too dangerous to

go beyond the fourth range. Sargent did not agree. He also did not agree with the manner in which Hutchins had handled the situation. His diary entry on September 28 shows his annoyance.

For my part, I would prefer to receive and obey order, rather than decide for myself and I am sorry to find Mr. Hutchins, who is our principal so fond of council and so wanting in decision. He is good character, a worthy man, but stands in need of confidence in himself—which we surveyors have all very sensibly felt, and which has sometimes involved us in disagreeable altercations and disputes about modes and forms and the more essential of our duties.

Isaac Sherman, third range surveyor, and Ebenezer Sproat, fourth range surveyor, had the option of returning to their work. Sargent asked for a similar privilege. Hutchins refused to order him to resume surveying but agreed to let him continue if he chose to do so. Sargent requested a military escort and went back to the field. The men were becoming worried, but Sargent was not to be turned aside. He wanted to finish the south line to the river and take the meanders of the Ohio. This would allow the sale of one range more than Hutchins had planned.

To accomplish his goal, Sargent hired more men. One of them was John Mathews, a well-educated New England schoolteacher who had not been able to find a teaching job. As was true of many of the men on early survey crews, he was attracted by the idea of adventure on the frontier. He became a chainman in a party now numbering 36 men. The march from camp back to the survey area was a slow one, but by the middle of October they were again at work.

Sometimes Sargent found the escort of troopers more trouble than it was worth. The men were not well equipped for the work and lacked proper clothing. Sargent sympathized with them and would have dismissed them except for the fact that his hunter became convinced that Indians were nearby.

When all the horses, except one sick one, were stolen, it became apparent that the hunter was right. Without the horses the work became far more exhausting. Then the weather turned bad and the men began hinting that they had done all the surveying they wanted to do for one season. Even Sargent started to feel apprehensive. So he completed the seventh township in range 5 in early November and returned to the surveyors' camp. Hutchins then wanted Sargent to finish the range. This made Sargent even more critical of Hutchins.

Survey Halted

Before Sargent could return to the field, however, General Richard Butler, superintendent of Indian Affairs, sent word that the Indians had demanded that the surveyors halt their work. As the bad weather would have made the survey extremely expensive even if there had been no Indian threat, Hutchins decided to comply with the Indians' wishes. On November 14, 1786, the survey was stopped for the year. Hutchins reported to Congress that four ranges and seven townships in the fifth range had been completed. About 800,000 acres had been surveyed and were ready for sale as a result of the work that season.

The surveyors, including Sargent, sent a memo to Congress asking for a provision to pay them for their expenses in the past and to increase their pay in the future. They said that they would take a part of this in land. Sargent's actual expenses were \$250, and his pay, at \$2 per mile, was only \$120.

Although Sargent had felt that his efforts were not appreciated by Hutchins, a comment Hutchins wrote showed quite the opposite. In it he spoke of the fact that Sargent had exerted himself to the best of his abilities for the "Public Good" and that he had lamented being unable to finish his range. When Sargent wrote to Hutchins the following year, offering his services to complete the fifth range, there were enough surveyors already at work and it was not necessary for him to cross the mountains to finish his work.

After the Ordinance of 1787 encouraging mass settlement was passed, Sargent was elected secretary of the territory northwest of the Ohio River. He was acting governor much of the time during the 10 years he served in this office. He left the old Northwest Territory in 1798 after accepting an appointment as governor of the just-organized Mississippi Territory.¹⁰²

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CONGRESSIONAL AUTHORITY FOR MANAGEMENT OF THE PUBLIC LANDS

Inevitably, in a new democracy, questions do arise concerning who has proper authority—the local, State, or National Government. As background for these conflicts, recall that the American colonists developed town and county governments based predominately on a shared English heritage and their needs as a frontier people. However, as time passed, conflicts arose between the Colonies and England. In 1774, in order to establish unity of action in regard to their common grievances against English colonial policy, the colonists convened the First Continental Congress.

COLONIAL INDEPENDENCE

This first step toward the creation of the Union was followed by the Declaration of Independence. Signed on July 4, 1776, this document made the Thirteen Colonies the Thirteen Original States. However, each State remained completely sovereign until the need for unified action during the Revolutionary War led to the adoption of the Articles of Confederation and Perpetual Union. In 1777, these were submitted to the States for ratification, which was completed in 1781, forming the United States of America.

Although a semblance of National Government existed at that point, there were weaknesses in the arrangement. Foremost was the fact that there was no national executive branch or judiciary. The Confederation had no power to regulate interstate and foreign commerce, and this lack soon led to serious economic conflicts between the States. To remedy these inherent weaknesses, a constitutional convention met in 1787 for the purpose of forming "a more perfect Union." Congress submitted the Constitution to the States for ratification on September 28, 1787, and, on March 4, 1789, it became legally operative as the "Constitution of the United States."

Authority for congressional disposition and management of the public lands and resources is derived from Article IV, Section 3, Clause 2 of the U.S. Constitution. The clause states that Congress shall have the power "to dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States. . . ." This congressional power has been held to be without limitation.

During the first year of the new constitutional form of government, Congress allowed the Land

Ordinance of 1785 to expire, although it reenacted (with some modification) the Northwest Ordinance of 1787.

LAND LAW UNDER THE CONSTITUTION

The Land Act of 1796, entitled "An Act providing for the Sale of the lands of the United States, in the territory north-west of the river Ohio and above the mouth of the Kentucky river," was the first new land law to take effect under the Constitution. Surveying, as authorized under the law, was confined to three areas—north of the Seven Ranges, west of the Seven Ranges, and west of the Symmes Purchase. Yet, in spite of these limitations, the Land Act of 1796 became the legal basis of all subsequent United States public land surveys.

Although it restated the basic principles of the Land Ordinance of 1785—frequently in terms very much like those of the earlier ordinance—the Land Act of 1796 did make some changes. Under the new law, the geographer, who had died in 1789, was to be replaced by a surveyor general who was to "engage a sufficient number of skillful surveyors," without reference to States, and proceed with the surveying.

Of particular interest to surveyors were the half-dozen words in the new law that called for north-south lines to be "run according to the true meridian." These few words restored an important provision of the Land Ordinance of 1785, which had been repealed as a convenience to the surveyors of the Seven Ranges.

The new law set the surveyor general's salary at \$2,000 per year and raised the pay of deputy surveyors for their labors from \$2 to \$3 per mile of line surveyed. The system of numbering sections was changed to the present system. Alternate section lines were to be traced in the field in alternate townships, thus forming 2-mile squares on the ground. Corners were to be set 1 mile apart on these lines, giving each section three corners that were actually set in the field. Under the Land Ordinance of 1785, the corners had been established by the surveyors along the township lines only, and the section (lot) lines were added on paper in the office.

Five-Mile Townships

On June 1, 1796, Congress approved "An Act regulating the grants of land appropriated for

Military services, and for the Society of the United Brethren for propagating the Gospel among the Heathen." This act provided for a special survey that did not conform with the general principles set forth in the Land Act. Under its provisions, the surveyor general was to "cause the said tracts to be divided into townships five-miles square, by running, marking, and numbering the exterior lines of the said townships, and marking corners in the said lines, at the distance of two and one half miles from each other, in the manner directed. . . ." This act applied to the lands in the United States Military District, although the State of Connecticut used the same plan in its Western Reserve.

Appointment of the Surveyor General

The appointment of a surveyor general was the first priority under the 1796 land law. President Washington selected Simeon De Witt, who had shared Thomas Hutchins' title of geographer to the United States during the Revolutionary War. De Witt, who was satisfied in his post as the surveyor general of New York State, declined the appointment. Thus, on October 1, 1796, Washington appointed Rufus Putnam as the first surveyor general of the United States.

It was a good choice. Putnam had been among those championing the settlement of the Ohio country for years. Only a short while before he became surveyor general, he had been named superintendent of the survey of Zane's Trace. This roadway, opened through the forest by Ebenezer Zane in 1796, was the only important road in the Ohio country of that time.²⁶

Putnam had also served as superintendent of surveys for the Ohio Company. He had supervised, on behalf of the Federal Government, the survey of lots at Gallipolis for the poor French farmers who had been induced by the Scioto Company to leave their homes and settle in Ohio—only to find, when they reached Ohio, that the Scioto Company had failed and there were no lands for them.

THE CONTRACT SYSTEM

Rufus Putnam's most enduring contribution to the public land surveys, lasting for more than a century, was the establishment of the terms under which deputy surveyors were to be employed. The idea of placing the responsibility upon the deputy surveyor for "the wages of chain carriers, markers and every other expense of executing the surveys," was spelled out in the Land Ordinance of 1785, but it required no binding contract calling for the completion of a specific assignment. The Land Act

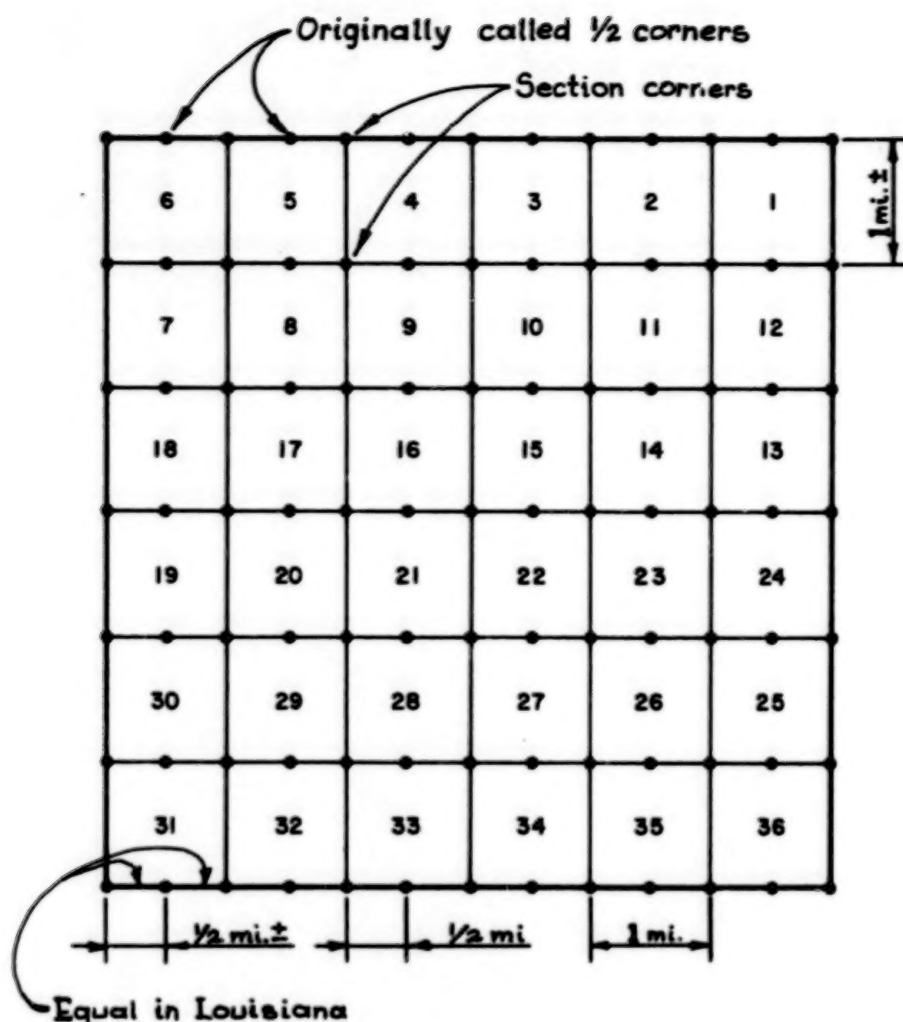
of 1796 did not even specify that deputy surveyors were to assume the responsibility for the expenses of the surveys; it provided only that "the President of the United States may fix the compensation of the assistant surveyors, chain carriers and axemen," and that the total amount paid for the surveying was not to exceed \$3 per mile.

Putnam's instructions from the Secretary of the Treasury, at that time the highest official directly concerned with the surveys, asked that Putnam be governed by considerations of economy, the natural course of settlement, the comparative fertility of the various tracts, and the probability of quick sale. The matter of the terms under which the surveyors were to be hired was left completely in Putnam's hands. Putnam chose to continue a practice with which he had become familiar as the superintendent of surveys for the Ohio Company—that of drawing up contracts binding the surveyors to the performance of specific surveying assignments, while allowing them to hire their own surveying crews.²⁶

In 1797, Absalom Martin, who had surveyed the first of the Seven Ranges, along with Zaccheus Biggs, received the first two surveying contracts issued by Putnam. They were for the subdivision of part of the U.S. Military District.²⁶ Under these surveying contracts, Putnam assigned a specific tract of land to each contract holder. The terms of the contracts limited the claims of the contract holders against the Federal Government to a set compensation for each mile of line surveyed, and made the contract holder accountable for rectifying any errors in the survey. The deputies hired their own surveying parties, and the men of the crews were required, as were the deputies, to swear to perform their duties faithfully. This contract system, inaugurated by Putnam, remained in effect until 1910.

THE ACTS OF MARCH 1 AND MAY 10, 1800

While Rufus Putnam was still surveyor general, two other congressional acts of great importance to surveyors were passed. The Act of March 1, 1800 (2 Stat. 14), set a precedent in the United States involving a surveying principle, mention of which can be found in the Bible. The act refers specifically to the 5-mile townships surveyed to reward military services and for the Society of the United Brethren. In effect, what it says is that a corner set under regulations by a surveyor in the field is a true corner, *whether interior lines extended from it are parallel to the exterior lines or not. It is a true corner even if later surveys indicate that it was placed incorrectly.*



Under the Act of May 10, 1800, excess or deficiency of measurement was placed in the north tier of sections and in the west tier of half sections. All section lines were run, and half corners (later known as quarter corners) were set on East-West lines. In early Louisiana surveys the excess or deficiency was divided equally in the last mile. Half sections were the smallest parcels of land sold. Dots indicate corners set in the field.

This vitally important principle of cadastral surveying was reinforced and applied to all public land surveys by the Act of February 11, 1805 (2 Stat. 313). Under its second section, this act provided that "All the corners marked in the surveys . . . shall be established as the proper corners of sections, or subdivisions of sections, which they were intended to designate. . . ."

The Act of May 10, 1800 (2 Stat. 73) provided for the subdivision of townships into half sections of 320 acres each. It also made provision for placing all excess or deficiency of measurement in the north mile and the west half mile in each township.

ISRAEL LUDLOW AND THE SURVEY OF THE GREENEVILLE TREATY LINE

Rufus Putnam apparently relied heavily upon the surveying services of Israel Ludlow, who had been another applicant for the post of surveyor general.²⁶ Ludlow had worked on both the survey of the Seven Ranges and the subdivisions of the Symmes Purchase under the Land Ordinance of 1785. At Putnam's request, Ludlow surveyed the Greenville Treaty Line. This line was based on the treaty signed on August 3, 1795, which guaranteed that the American settlement in the Northwest Territory was secure from Indian attack as far west

Even in Biblical times, the corners established by surveyors in the field were intended to be permanent markers of the land:

Thou shalt not remove thy neighbor's landmark which they of old times have set in thine inheritance which thou shalt inherit in the land that the Lord thy God giveth thee to possess it.

Deuteronomy 19: 14

Cursed be he that removeth his neighbor's landmark. And all the people shall say, Amen.

Deuteronomy 27: 17

Remove not the ancient landmark, which thy fathers have set.

Proverbs 22: 28

Remove not the old landmark; and enter not into the fields of the fatherless.

Proverbs 23: 10

The Bible offers a good description of a surveying party:

Give out from among you three men for each tribe and I will send them, and they shall rise, and go through the land, and describe it according to the inheritance of them: and they shall come again to me.

Joshua 18: 4

It also tells of the field notes returned by the surveying party after they had completed their work:

And the men went and passed through the land, and described it by cities into seven parts in a book, and came again to Joshua to the host at Shiloh.

Joshua 18: 9

as a line that met the Ohio River at a point opposite the mouth of the Kentucky River. This was the land, other than that already patented, to which the Land Act of 1796 specifically applied.

Ludlow began the survey of the Greeneville Treaty Line at what the treaty called "the crossing place above Fort Lawrence." Putnam himself journeyed north to mark the beginning point—a crossing place over the Tuscarawas branch of the Muskingum River a mile or so upstream from Fort Laurens.²⁶ During the 1797 survey season, Ludlow surveyed the line in a southwest direction for a

distance of 150 miles to Loramies Store on the upper waters of the Great Miami River.²⁶ Ludlow finished running the treaty line in 1799 by first surveying the line from Loramies Store to Fort Recovery and then southwest to a point opposite the mouth of the Kentucky River, as specified in the treaty.

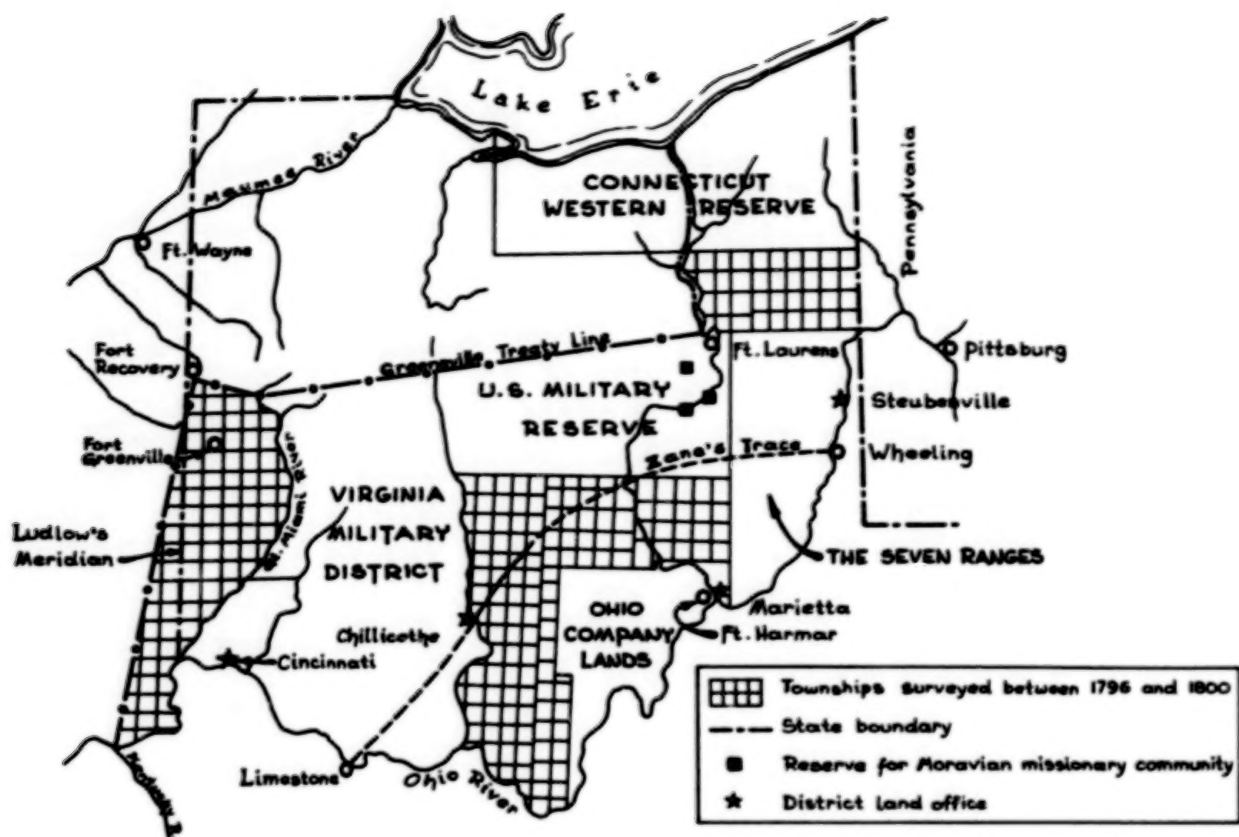
The Indians had requested that a wide corridor be cut through the forest all along the line so that it would be impossible for white settlers to overlook it in their search for land to live on. However, since there were no funds available with which to hire extra axemen for this work, the treaty line was marked in the same manner as other survey lines—by stakes and marked trees.²⁶ Since the time Israel Ludlow first used them, two hacks (or notches) on line trees have been required under approved surveying practice.⁷

Public Land Eligible for Survey in 1796

The lands eligible to be surveyed as public lands under the Land Act of 1796 were largely bounded by the Greeneville Treaty Line. This treaty line, which was to permanently separate white settlements from Indian villages and hunting grounds, turned out to be only the first of many such boundaries. All were set forth in solemnly sworn treaties, yet each boundary, in its turn, gave way as new treaties with wider boundaries were signed. In this way, American settlement moved relentlessly westward toward the Pacific. Nevertheless, in 1796 the United States Public Domain included only the land north of the Seven Ranges, east of the Tuscarawas River, and south of the 41st parallel (which had been designated as the south boundary of Connecticut's Western Reserve), and the public lands west of the Seven Ranges. It did not include the Virginia Military Reserve, the Ohio Company's Purchase, the Symmes Purchase, nor the area set aside by Congress as the United States Military District, even though that land also had to be surveyed.

Subdivision of the U.S. Military District

Ludlow stopped work on the treaty line in 1798 and went to the United States Military District. Putnam had divided the Military District into five areas for surveying purposes, and had assigned Ludlow to one of them. Other surveyors of the Military District included Zaccheus Biggs, Absalom Martin, John Jackson, and John Mathews.²⁶ All of the returns on the subdivision of the Military District were in Putnam's hands before the end of November 1798.²⁶ This included the returns for the



FIRST THREE AREAS SURVEYED UNDER THE LAND ACT OF 1796

three small tracts of land within the Military District that had been set aside for the Society of the United Brethren. These small tracts, which had been surveyed in 1797, were actually the first surveying assignment to be completed under Putnam's direction.

Ludlow's Meridian

In the autumn of 1798, after he had finished his field work in the United States Military District, but before he completed the survey of the Greenville Treaty Line, Israel Ludlow began a public land survey in an area far removed from other public land surveys—the area west of the Symmes Purchase. This was the first public land survey initiated without reference to another survey since Thomas Hutchins started the Geographer's Line in 1785. Under Rufus Putnam's direction, Ludlow surveyed the line north from the mouth of the Great Miami River. Using this line as a reference meridian, he then began the subdivision of the public land area west of the Symmes Purchase.

EARLY SURVEYS IN INDIANA

The line Ludlow surveyed north from the mouth of the Great Miami was later named the First Principal Meridian. It divides Ohio and Indiana and governs Indiana public land surveys east of the Greenville Treaty Line. This area, known as "the Gore," was given to Indiana by the Ohio Enabling Act of April 30, 1802.¹⁰⁴ The range line that begins at the confluence of the Ohio and Little Blue Rivers and runs to the northern boundary of Indiana is the Second Principal Meridian. It governs all the public land surveys in Indiana with the exception of those within "the Gore." Other surveys were made in Indiana before Indian title was extinguished, but, as title passed to the United States, the rectangular system of surveys was established.

The Vincennes Tract

In 1742, long before the United States surveys began, the Indians gave the French a tract of land lying at right angles to the course of the Wabash

River at Vincennes. In 1763, the English took it away from the French, and, in 1779, General George Rogers Clark took it from the English. The Vincennes Tract contains about 1.6 million acres. The western part is in Illinois, but by far the largest part is in Indiana.

If a line were drawn on a map of Indiana from Point Coupee on the Wabash near Merom in Sullivan County to Orleans in Orange County, it would show the approximate north boundary of the tract. It terminates at the point called "Freeman's Corner," which lies due east of Vincennes. Further, if the line were drawn from there to the southeast corner of Dubois County, that would show the approximate east boundary of the tract. If the line were continued northwest from there to the mouth of the White River on the Wabash, it would provide a reasonable outline of the part of the Vincennes Tract that lies in Indiana. Before the rectangular surveys could be extended to this tract, the outline of it had to be surveyed.

Freeman's Survey Party

On May 1, 1802, Congress provided for the survey of land in the vicinity of Vincennes. Thomas Freeman began the survey of the lines and corners of the Vincennes Tract in late summer of that year. It is not known how many men were with Freeman; his field notes termed it a "little party." We do know there were chainmen, axemen, a flagman, at least one cook, a packer, and teamsters.

There were also hunters with the party. The weapons they used were of fairly soft metal, flint-lock, smooth-bore Kentucky or Tennessee long rifles. Hunters for hire on the frontier of the time enjoyed contests to test their skill, and often perfected their craft to a point where they could hit either eye of a target as small as a squirrel. This was no small matter, as the meat supply as well as the safety of the party depended upon these men.

The clothing worn by Freeman's men—and Buckingham's, two years later—was the same sort worn by other men on the post-Revolutionary War frontier. Buckskin pants and shirts, boots (or moccasins and leggings) and raccoon-skin caps were the usual attire, although sometimes the flagman wore a red flannel shirt so that he might be seen more easily.

Matches were not invented until a quarter of a century after the survey of the Vincennes Tract, so flint and steel gave these men their fires. The fires provided heat for cooking, warmth on cold nights, and fuel to heat the metal to be ladled into the bullet mold. The molding of bullets took a steady hand

and a good eye. The amount of molten metal poured into the mold had to be exactly right or the result was a ball lacking the necessary perfection. The fire also provided light for copying out the field notes for the day.

Freeman's Notes

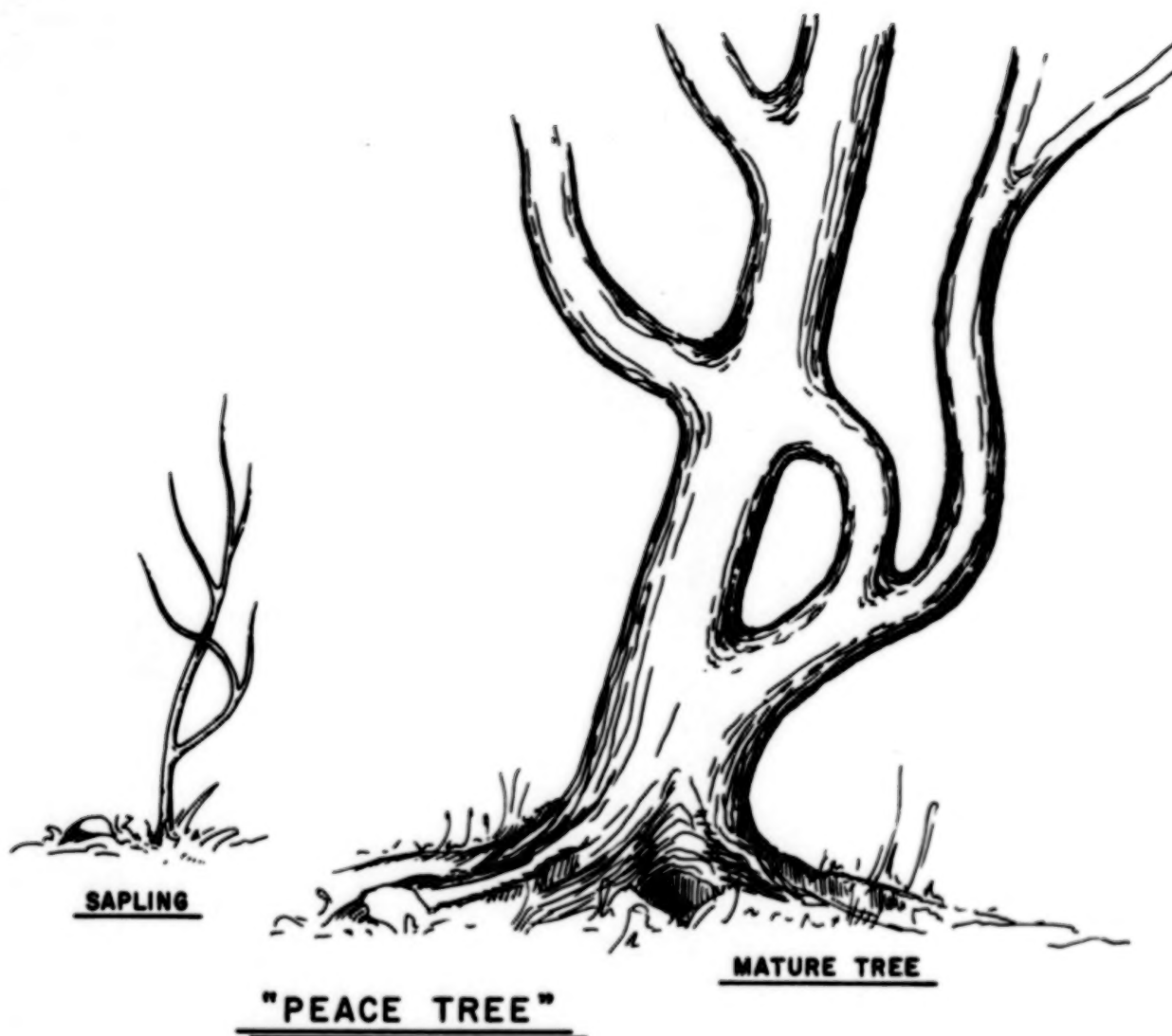
The field notebooks of Freeman's time are usually about 3 by 6 inches. They are handmade from old-fashioned paper called foolscap. Most of them were stitched together with all the neatness that a surveyor working by firelight in the wilds of 1802 Indiana could muster; some of them were not stitched at all, they were simply tied together with very thin strips of buckskin.

As he worked, Freeman carried all the small items he needed to have with him. He probably used a buckskin pouch suspended from his shoulder by a strap. This was a common practice as it left the surveyor's hands free. Among the items usually considered necessities in those days were such things as several wild goose feathers, an ink horn, and a sand horn. The goose feathers were sharpened into quill pens as needed, the ink horn held ink brewed from forest bark; the sand in the other horn was used to dry the ink. In fact, grains of sand can still be found between the pages of these old notebooks.

And, as faded as they are, Freeman's field notes reflect his care as a surveyor. He noted such things as Indian trails, very large springs, and other features. When he crossed the Yellow Banks Indian Trail in his survey, he recorded it as 31 miles and 41 chains from the mouth of the White River. Occasionally, Freeman's men split a sapling and pushed a limb through the trunk. These small trees that became large, enduring, oddly formed markers of a survey line, were called "peace trees," as they marked a treaty line.

Apparently, when Freeman was nearly finished with the survey, the United States went back to before the French title and bought the land from the true original owners—the Indians. At the time of the treaty (June 7, 1803), Fort Wayne was really a fort, and the document used to describe the boundary was Freeman's survey. Because of this method, any doubt about the title was cleared away.

Surveyors were sent to survey the Vincennes Tract into townships and ranges soon after the Fort Wayne Treaty was signed. The Second Principal Meridian passes very near "Freeman's Corner." The base line runs east and west near the center of the tract. Contracts held by deputy surveyors



called for the tract to be surveyed, in ranges 6 miles wide, north and south from Freeman line to Freeman line.

Other Freeman Surveys

This was not the first time Thomas Freeman had been given a large and difficult job of surveying, nor was it the last. On October 27, 1795, a treaty defined the boundaries between the United States and the Spanish Colonies of East and West Florida. The treaty was ratified March 3, 1796, and on May 24, 1796, Thomas Freeman was appointed surveyor for the United States for the purpose of running the international boundary line as called for in the treaty.¹⁰⁴

The boundary line between Alabama and Tennessee is the 35th parallel of north latitude.

Thomas Freeman made sextant observations for latitude in October 1807. He marked a point estimated as the 35th parallel, which was the northern boundary of Mississippi Territory in those days, and ran the line between the Elk River and the old Cherokee line.³⁴ This is the base line of the Huntsville Meridian.⁷⁴ The part of the Alabama-Mississippi boundary from the mouth of Bear Creek on the Tennessee River to the northwest corner of what was then Washington County, Alabama, was surveyed in 1820, by John W. Exum, deputy surveyor under the direction of Thomas Freeman and John Coffee.⁷⁴

Thomas Freeman, then, was clearly a surveyor with extensive experience long before he reached Indiana—a surveyor who had earned the trust of his country. That he continued to merit this respect is evidenced by the fact that, from 1820 until his

death in November 1821,⁹ he was surveyor general of the Public Domain south of the State of Tennessee.¹⁰⁴ Although this office was a political one, experience did count in this instance.

French Claims

Within the Vincennes Tract were claims of early French settlers. The United States honored these claims and used the French system in surveying them. Usually, they consisted of 400 acres, lying in long, narrow lots at right angles to the rivers. The deputy surveyors who contracted to subdivide the Vincennes Tract closed upon these French boundaries.

Settlers started for Vincennes as soon as the treaty was in effect. Shortly after Buckingham set his first section corner, a land office was established and the new land was opened for settlement. Many people came from Kentucky; because there was no rectangular system there, many of Kentucky's pioneers had lost their land simply because there had been no survey. Many titles were in doubt, including those of Thomas Lincoln and Daniel Boone. Hundreds of families came to Indiana by way of the old trails across Indian land. To ensure the safety of the pioneers, the purchase of the land crossed by these trails was necessary.

The Buffalo Trace

The most notable early land route in the area entered Indiana at the Falls of the Ohio and followed a generally northwest course to Vincennes. It was called the "Buffalo Trace," for buffalo had made it and used it in uncounted numbers. It was the most prominent of the several buffalo trails in the Indiana of that era, and it had been the most important trail as long as Indian memory before that. It was significant enough, in fact, to be used as a means of determining a treaty line.¹⁰⁴

The Vincennes Treaty

The Vincennes Treaty was negotiated between General William Henry Harrison and the Indians in 1804. The treaty called for all of the Buffalo Trace to be within the tract ceded to the United States, and for the boundary in that part to be a straight line, parallel to the "road" from the eastern boundary of the Vincennes Tract (granted to the Americans in the Fort Wayne Treaty) to Clark's Grant. The line was to be no more than a half mile from the northernmost bend in the road.

The location of the "straight line" was established by first surveying the Buffalo Trace by chain and

compass. This was done by a surveyor named William Rector, who became surveyor general of Illinois, Missouri, and Arkansas in 1814. Beginning on July 11, 1805, trees were marked each mile along the trail with the distance from Clark's Grant. The Vincennes Treaty permitted settlers to enter Indiana across land owned by the United States.

THE SECOND PRINCIPAL MERIDIAN

The Vincennes Treaty and the land between the Ohio River and the Vincennes Tract covered by it are probably the reason for the location of the Second Principal Meridian. The base line was surveyed in 1804 by Ebenezer Buckingham, Jr. The line began at a point on the Freeman line on the south side of the Vincennes Tract in Illinois and ran east. Buckingham marked trees along his line, kept his notes, and set mile and half-mile posts. He did not set any corners, he merely ran a line east for a distance for $67\frac{1}{2}$ miles.

It was autumn when Buckingham began surveying at Thomas Freeman's southeast corner of the Vincennes Tract and ran a line due north (now the Dubois-Orange County line) until he reached his base line. After intersecting the base line, at a point 3.60 chains east of his previously set $67\frac{1}{2}$ -mile post, he went east on the base line, marking section corners, half-section corners, and witness trees. He recorded them as he went along until he met the Freeman line on the east end of the Vincennes Tract. Beyond that lay Indian land, so Buckingham returned to the intersection point on the present county line. He then went west along his base line, marking his corners and witness trees, and probably resetting all his mile and half-mile posts 3.60 chains east, until he was again in Illinois at the south Freeman line.¹⁰⁴

When Buckingham began recording section corners, he recorded two beech trees as witness (bearing) trees. These are very special trees. Both are north of the base line; one is in Dubois County, the other in Orange County. They are the "witness" trees for the corner of four townships, and they are the first ones on record, in reference to a township corner, in all the surveys controlled by this base line and the Second Principal Meridian.¹⁰⁴

In September 1805, Ebenezer Buckingham extended his base line east to a point 12 miles from the Dubois-Orange County line. He then ran the line north to the north line of the Vincennes Treaty line (not the Vincennes Tract line—the treaty line surveyed by William Rector). This Buckingham north-south line is the Second Principal Meridian. The location makes sense when the facts as they existed at the time of the survey are considered: it is

there because it is 12 miles (two ranges) east of the southeast corner of the Vincennes Tract. The northeast corner of the tract could not have been used as a basis for establishing a principal meridian at the time surveyor Buckingham contracted to do the work, because one step north or south of that corner would have put him on Indian land.

THE TEN O'CLOCK LINE

Clashes with Indians were fairly common occurrences, but Deputy Surveyor John McDonald had more than the expected amount of interference from them when he undertook the survey of the northeast line—the "Ten O'Clock Line"—of the Harrison Purchase. This line begins where Raccoon Creek enters the Wabash River and runs southeast to a point 30 miles from the northeast "Freeman Corner."¹⁰⁴

By 1809, the Indians had seen the results of several treaties. They were becoming aware of the loss of their land. They saw numbers of white men in the area south of where once only Indians had been. The deputy surveyors, who arrived as soon as the treaties were signed, had begun to symbolize the wave of settlement that so swiftly followed them. By this time some 250,000 trees had been marked by surveyors. To the Indians, these hacks, blazes, and other cryptic symbols were sure signs of an advancing alien culture—signs that their lands were slipping from them. By the time of the Harrison Purchase, the total amount of land ceded to the United States under treaties signed by Harrison was close to 30 million acres.

There is a tale that the "Ten O'Clock Line" got its name from the Indians' suspicion of the surveyor's instruments. They wanted to mark the line by the shadow cast by the sun and an upright stake at 10 o'clock in the morning, because the surveyor could not manage the sun as he did the compass.¹⁰⁴

Indian Conflict

The Indian leader Tecumseh was suspicious not only of the instruments, he was also dissatisfied with the sale of the land south of the Ten O'Clock Line. He insisted that all the Indians held all the land in common and that no tribe could sell any of the land because it belonged to all Indians. Harrison, of course, believed that Indians had a right to dispose of the land that they occupied, that it was theirs by right of occupancy. The discontent Tecumseh and some of the warriors felt about the treaty and the surveys continued to grow. In 1811, it led to the Battle of Tippecanoe.

In November 1819, the conditions were still less than ideal, as noted by a surveyor near the Indian town called Mississinewa:

... the Indians held another council on the 6th ... which was much against me. My provisions were much wasted here, as we had to accompany their chiefs to the town, where the Indians made free with my bread. On the seventh they added another chief to my survey party, which I had to support with bread and meat.

The situation rapidly grew worse. A later entry in the field notes reads:

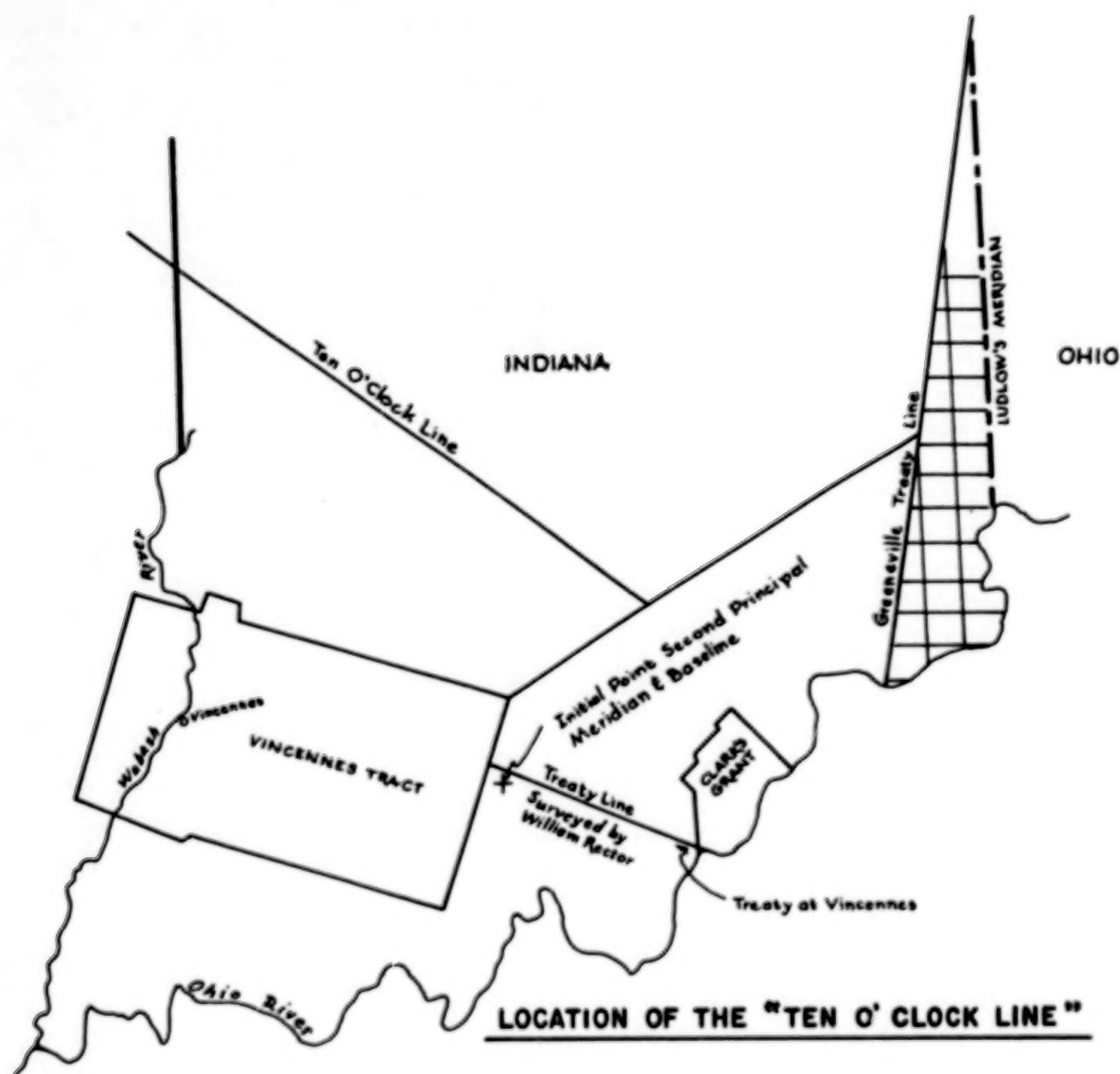
Here the Indians, in an imperious manner told me I was going wrong, and said I should go no farther that way, saying that I was going to go to their town and if I would not go 10 miles east of the town they would not let me go on. I saw by their looks and the way they behaved that I was unsafe, so I stopped. They would scarcely permit me to make a mark and appeared displeased. We left the line and started for Fort Recovery [Ohio] where we arrived on the 29th of the month [November 29, 1819].

This entry is signed, "J.S. Allen, D.S." The next paragraph in the field notes begins "March 18, 1820. Began where the Indians stopped me on the 25th of November, 1819," Deputy surveyor Allen persevered: he began this survey on November 3, 1818, and completed it on March 20, 1820.¹⁰⁴

Other Problems

Northwestern Indiana presented its own forms of difficulty. Deputy Surveyor Uriah Biggs reported in January 1835 that Township 33 North, Range 6 West, had only a small part which could be cultivated. He found the Kankakee River a "sluggish stream, its banks very low and lined on each side with a heavy growth of timber, mostly ash ... undergrown with swamp alder and wild rose, etc. ... covered with water during the season." Surveyor Biggs described the soil in "this forest or swamp" as loose yellow sand and mentioned that he could approach the river only when the swamp was frozen.

Jeremiah Smith, working 12 miles east of Uriah Biggs, did not find things much better. He could not see his line at all. It was in the "expanded water of Yellow River." Of the next township north, Township 34, he had this comment: "There is but little room left for general remarks in this township. There is such an endless sameness of marsh ... that there is nothing upon which to digress from the monotony of lamentation."



Salt Springs

Sometimes the deputy surveyors made rare finds. Edward W. Tupper and Augustus Stone, surveying in Township 1 North, Range 2 West, Second Principal Meridian, made note of a prominent salt spring. The surveyors estimated the quantity of water to be "sufficient to form a sheet of water two feet wide and one inch deep." About four chains southeast they found another salt spring with more than twice the amount of water afforded by the first spring. The two springs joined a fresh water spring located between them, and formed a creek from 12 to 20 feet wide. Salt springs occasionally could be seen boiling up through the stream. Several springs, both salt and fresh, united

to form a creek about 8 inches deep, which seemed to stay very salty. The field notes indicate that the two surveyors made special note of both section 3, Township 1 North, Range 2 West, and section 34, Township 2 North, Range 2 West, because of the salt discovery. The surveyors did not give these springs the names they are now called; French Lick and West Baden were just "Salt Springs on Salt Creek," on the 1804 survey plat.¹⁰⁴

Ziba Foote

Two years after the discovery of these salt springs, Ziba Foote became one of the adventurous young Indiana surveyors. Born in 1785, he was a bright Connecticut Yankee who had

graduated from Yale with high honors at the age of 20. He began surveying under the direction of William Rector, deputy surveyor to Surveyor General Mansfield of Cincinnati, soon after his graduation.

One of Foote's first assignments was the survey of a pond in Township 3 South, Range 13 West, Second Principal Meridian. The pond was about 20 chains across and nearly a mile long. It appeared to be quite shallow, and he started through it with his compass and his Jacob's staff fastened to his belt. A little way out he found himself over his depth and too weighted down to regain his footing. He drowned before anyone could reach him. The men recovered his body and prepared a bark coffin. They buried him on a knoll near the pond, which they named "Foote's Grave Pond."¹⁰⁴

David Sandford

Surveyor David Sandford was born in Newtown, Connecticut. Sandford, like Foote, also went to Yale, graduating in 1804. In 1805, he subdivided

Range 5 of the Vincennes Tract. He obtained a contract to survey four townships on the Maumee River, but became ill and died at Fort Wayne, October 11, 1805, at the age of about 25. George R. Wilson, one-time county surveyor of Dubois County where young Sandford worked, resurveyed a number of his lines in Range 5, and bore witness to Sandford's efficiency. In his field notes David Sandford mentioned a "remarkable ledge of rocks on the north bank [of White River]." That ledge is still readily identifiable because Sandford did exactly what most young men would have done: he cut his initials—D. S.—into the rock.

Some of the words and phrases found in the field notes written by deputy surveyors during the early 1800's sound strange now. They mention "middling soil," "sorry land," "gladly land," and "wavely land." They rose [went up] a hill, or found a "handsome spot." No matter how strange their expressions sound now, however, these men executed the most creditable surveys that had been done up to that time.¹⁰⁴

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THE REFINEMENT OF THE RECTANGULAR SURVEY SYSTEM

THE LOUISIANA PURCHASE

Thomas Jefferson became President of the United States in 1801 and learned, almost immediately, that Spain had given Louisiana to France under a secret treaty. In order to rid this country of the possibility of any colonial ambitions that Napoleon might have, Jefferson asked him to consider selling his holdings in America. While he awaited an answer, the President quietly planned to send an expedition across the continent. In preparation for the journey, Jefferson sent young Meriwether Lewis to Philadelphia, where Robert Patterson and Andrew Ellicott instructed him in mathematics and surveying.²⁰ Meanwhile, in April 1803, Napoleon agreed to sell Louisiana to the U.S. The deal was completed and the United States thereby more than doubled its territory.

When Captain Meriwether Lewis and his co-leader Lieutenant William Clark started their historic expedition in the late spring of 1804, they were able to travel from the mouth of the Missouri River all the way to the Rocky Mountains on land owned by the United States.

JARED MANSFIELD

The year 1803 also marked an advance in the development of the rectangular surveys. Jared Mansfield, who was Thomas Jefferson's personal choice for the office, replaced Rufus Putnam as surveyor general.

Mansfield, in his mid-40's, was a brilliant and technically able man. He had been acting professor of mathematics at the U.S. Military Academy at West Point prior to his appointment as surveyor general. It was he who recognized the need for establishing base lines and principal meridians as a system of control for the rectangular surveys.

When Mansfield anticipated the survey of the Vincennes Tract in Indiana, he found himself faced with some perplexing problems. For one, the Vincennes Tract lay in the interior of the territory and was completely unconnected to any other public land. It would have been impractical to carry the old plan of numbering townships and ranges into such an area. In addition, there were no natural or permanent boundaries from which to begin the surveys. Also, the acquisition of Indian lands separating the Vincennes Tract from older

cessions was being considered and there was no point in carrying existing confusion—which experience in Ohio had by this time been shown to be considerable—into areas not yet acquired. A plan of survey was necessary and, fortunately, Surveyor General Mansfield was able to develop one.

The Plan

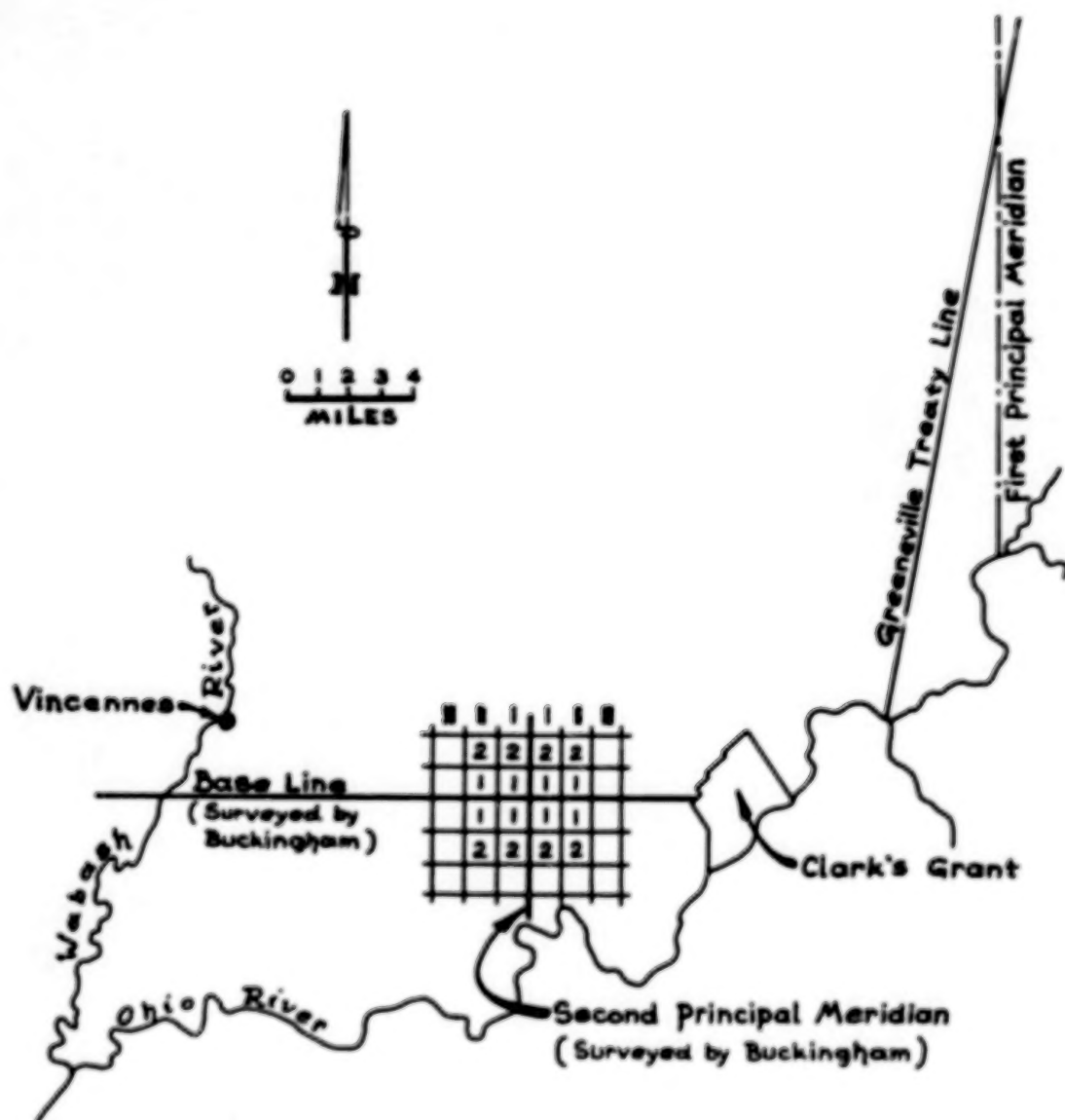
The segments of Mansfield's plan existed before 1800, but no one had seen them as a basis for a system for organizing the rectangular surveys.

Ellicott's Line was a meridian and the Geographer's Line was a base line, but Hutchins did not use their intersection as a basis for township identification. The south boundary of the United States Military Tract was a base line from which Putnam numbered townships northward, but elsewhere he continued to use the Ohio River as a basis for the numbering of townships. In the area west of the Symmes Purchase, Ludlow established a reference meridian from which he numbered ranges both east and west, but he did not survey a base line.

Mansfield saw these scattered segments as the basis of a unified plan. When Ludlow's Meridian was renamed the First Principal Meridian, and the positions of the Indiana base line and the Second Principal Meridian were established by astronomical observation, the pieces became a system of rectangular coordinates. Mansfield's plan of intersecting meridians and base lines, introduced in 1804, immediately provided a convenient basis for township identification. Later, it was also used as the basis for the compromise necessary in the execution of rectangular surveys of the surface of a spheroidal planet.

Legislative Changes

About this same time, changes in the land system were also brought about through legislation. On March 3, 1803, Congress amended the Land Act of 1800 and created the office of surveyor of the lands south of Tennessee. The duties of this officer were not unlike those of the surveyor general of the lands northwest of the Ohio River and above the mouth of the Kentucky River. The appointment of Isaac Briggs to this office marked the beginning of the era in which the number of surveyors general,



MANSFIELD'S PLAN OF THE PRINCIPAL MERIDIAN AND BASE LINE, 1804

and their influence, was to increase as the surveys stretched across the continent.

The Act of March 26, 1804 (2 Stat. 277) extended the authority of the surveyor general over "all of the public lands of the United States to which the Indian title has or shall hereafter be extinguished, north of the river Ohio, and east of the river Mississippi. . . ." This act also provided that:

whenever any of the public lands shall have been surveyed in the manner directed by law, they shall be divided by the Secretary of the Treasury into convenient surveying districts;

and a deputy shall . . . be appointed by the surveyor general for each district . . . whose duty it shall be to run and mark such lines as may be necessary for subdividing the lands surveyed as aforesaid, into sections, half sections, or quarter sections. . . .

The Act of February 11, 1805 (2 Stat. 313) contains the last really important statutory amendment to the original Land Ordinance of 1785. Since its original enactment, this law has had particular significance for surveyors. Among other things, it provided for the completion of surveys previously

made by running alternate mile lines under the Land Act of 1796 and for the partial subdivision into quarter sections of lands "purchased previous to the first day of July last. . . ." Its provision for the subdivision of new public lands was reenacted under the Revised Statutes in 1874 (Sec. 2396, Rev. Stat.) and is still in effect.

THE GENERAL LAND OFFICE

Josiah Meigs, who had worked under Thomas Hutchins on the survey of the Seven Ranges,¹ was appointed surveyor general of all the public lands east of the Mississippi River when Mansfield resigned the office.

Meanwhile, half a dozen clerks of the Treasury Department had been keeping land records in addition to their other work. By 1812, the work load had increased to a point where this was no longer possible. The guardianship of the public lands demanded a more effective national office to handle the administration of this country's Public Domain.

Thus, by the Act of April 25, 1812 (2 Stat. 717), Congress established the General Land Office as a bureau of the U.S. Treasury Department. The chief officer of the GLO was a commissioner whose duties were "to superintend, execute, and perform all such acts and things touching or respecting the public lands of the United States . . . as have heretofore been directed by law to be done or performed in the office of the Secretary of State, of the Secretary and Register of the Treasury, and of the Secretary of War."

Under provisions of this act, all officers or employees of the General Land Office were forbidden to "directly or indirectly be concerned in the purchase of any right, title, or interest, in any public land. . . ." The post of surveyor general, however, remained independent of the GLO, a circumstance that created problems for several years to come.

Edward Tiffin

Edward Tiffin, an Ohio statesman and former surveyor, was chosen as the first commissioner of the General Land Office. Tiffin immediately set about planning and developing a more efficient system of land management. At that time, the records, surveys, maps, and reports regarding the public lands were found in various places in all the branches of the Government, particularly the State and War Departments. Under Tiffin's direction, this information was brought together and arranged in

useful order, permitting, for the first time, the efficient administration of public land matters.

1812 Land Bounties

The creation of the General Land Office took place on the eve of an impending struggle with Great Britain. It was not a popular conflict, so the Government again resorted to the offer of bounty lands to encourage military enlistments. Some 6 months before the war began, Congress authorized the creation of three new military districts. One of them was in an unspecified part of Michigan Territory, one between the Illinois and Mississippi Rivers in Illinois Territory, and the other between the St. Francis and Arkansas Rivers in Louisiana (later Arkansas Territory). Military warrants were to be issued and 6 million acres were to be surveyed. After surveying these areas were to be opened for entry by the holders of the military warrants.

Townsites

On June 13, 1812, Congress granted public lands for townsites and confirmed the boundaries of some towns that already existed in Missouri. This act, as it was later amended, became the basis for the survey and use of public lands for new townsites and town holdings in unreserved areas of the Public Domain. Five days after the passage of this act, Congress declared war against Great Britain—and thus began the War of 1812.

Business as Usual

Near the end of 1812, Commissioner Tiffin submitted a report to the 13th Congress regarding the accomplishments of the first year of the new system of Federal land management. The report featured an exhibit compiled with the help of the surveyors general, especially Josiah Meigs of Ohio. For the first time the exhibit showed the location and quantities of the public lands, together with data regarding such specifics as mineral deposits, military land bounty tracts, and large stands of timber.

By that time there were 16 district land offices operating as part of the new system headed by Tiffin. The State land offices in Ohio were at Steubenville, Marietta, Chillicothe, Cincinnati, Zanesville, and Canton. In Louisiana the offices were at New Orleans, Opelousas, and Ouachita. Territorial land offices were at Detroit, Michigan; Vincennes and Jeffersonville, Indiana; Kaskaskia, Illinois; Washington, Mississippi; and St. Stephens and Huntsville, Alabama.¹

THE WAR OF 1812

In June 1814, General Andrew Jackson succeeded General William Henry Harrison as commander of the 7th Military District, composed of Tennessee, Louisiana, and the Mississippi Territory.

Robert A. Butler, who had served as a captain under Harrison during the Indian Wars, transferred to Jackson's command as adjutant general.¹²⁹ In 1814, Col. Butler was commissioned by Jackson to leave Mobile and return to Tennessee to raise a force of mounted volunteers for the command of General John Coffee.¹²⁹

In late August 1814, near the end of the War of 1812, British troops marched into Washington and set fire to several government buildings. Among those burned was the two-story frame building that housed both the State and Treasury Departments. The building was a total loss and the records of the General Land Office were destroyed.²

Treaty of Ghent

On Christmas Eve of 1814, a treaty of peace was signed at Ghent, Belgium, between Great Britain and the United States, which also settled some of the disputed land boundaries. Because news traveled slowly in those days, however, the famous Battle of New Orleans actually took place several days after the end of the war. Robert Butler was with Jackson during that fight and, at the close of the battle, he and two other officers went out to meet the flag of truce brought forward by the British.¹²⁹

THE SURVEY PLAN PERFECTED

Meanwhile, in 1814, in a very neat exchange of jobs, Josiah Meigs became the second commissioner of the General Land Office and Edward Tiffin became the surveyor general of territories east of the Mississippi, a position he held for the following 15 years.

With great administrative energy, and without adding to his staff of 10 clerks, Meigs managed to improve clerical procedures and enlarge facilities to better cope with various types of land transactions. He planned that the functions of the GLO would include collections of various scientific data. Meigs was particularly interested in meteorology and hoped to have the registers of the various local land offices return meteorological observations along with their regular reports.²

Although Congress did not adopt his plan, Meigs did not give up his idea. On April 12, 1817, he sent a

circular to the registers of the local land offices asking for their voluntary assistance in making certain regular weather and other scientific observations.⁷³

As surveyor general, Edward Tiffin was responsible for the solution to the problem that had perplexed surveyors from the beginning of the rectangular system—the paradoxical requirement that townships were to have sides running in the cardinal directions and that they were to be rectangular.

Surveyors knew from the outset that fulfilling that requirement would be made impossible by the fact that the Earth is spheroidal. There had even been discussions before the Continental Congress about the problem, but nothing was done about it until Tiffin devised a plan of correction lines and offered it as a solution.

GUIDE MERIDIANS AND STANDARD PARALLELS

When Jared Mansfield was surveyor general, the Indians still held central and northern Indiana. As a result, the surveys completed under his leadership did not extend far from the base line. Gradually, as Indian title was extinguished, the surveys began to reach farther north, and it soon became apparent that additional controlling lines were necessary.

In submitting a plan for extending the surveys in Indiana, Tiffin first proposed, on March 20, 1819, that a "line of correction" be run between Townships 16 and 17 north of the Second Principal Meridian. If this was not done, he wrote, the ranges would be diminished to a point that the townships would no longer be 6 miles square. Tiffin's plan of guide meridians and standard parallels, as it was used and refined, became one of the most important parts of the public land survey system.

The spacing of guide meridians and standard parallels has not always been the same. From the time Surveyor General Edward Tiffin first suggested "lines of correction" until 1851, surveyors general were instructed that correction lines were to be run at "stated distances" north or south of the base line. The distances were then stated in the correspondence or instructions that accompanied the surveying contract in each case.

The instructions to the surveyor general of Oregon, issued in 1851, stated that standard parallels were to be run at distances of four townships north of the Columbia River and five townships south of the Columbia. These distances were repeated in 1855, when the General Land Office published the first "Manual of Surveying Instructions."

The 1881 Manual altered the 1855 Manual and required that the public lands be divided into "bodies of land 24 miles square, as near as may be." Standard lines and "auxiliary meridians" were to be at 24-mile intervals. The 1890 Manual referred to "guide meridians" rather than "auxiliary" meridians. The 1930 Manual retained the previous requirements and added a provision for intermediate auxiliary standard parallels or guide meridians. Some original lines had been run at intervals of more than 24 miles, therefore, it was

necessary to limit the errors of the old surveys or to add additional lines for the control of new ones. These intermediate lines were, and still are, run exactly like regular standard parallels or regular guide meridians, since their purpose, as stated in the 1930 Manual, is the establishment of controlling lines "at intervals sufficiently near each other to maintain a practical workable adherence to the legal definition of the primary unit, the township 6 miles square. . . ."

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PIONEER SURVEYORS

As has previously been mentioned, Congress offered bounty lands to men as an inducement to serve in the War of 1812—in Michigan Territory, between the Illinois and Mississippi Rivers in Illinois Territory, and between the St. Francis and Arkansas Rivers in the part of Louisiana Territory that later became Arkansas. Six million acres were to be surveyed and opened for entry by warrant holders who were allowed to choose the area in which they wanted their land located. Other than that, location was to be by lottery.

1815 MICHIGAN REPORT

In 1815, Edward Tiffin, who was in charge of the survey of the military tract in Michigan, made a report on the land his men had surveyed there. The highly unfavorable report described low wet land, numerous marshes and swamps, scrubby oaks, and barren soil, where not even one acre in a hundred was worth cultivating.

Tiffin's report was enough to cause Congress to abandon the Michigan tract. To make up for it, 500,000 acres in the Missouri Territory were added to the Illinois tract. There were, however, a few hardy souls who read Tiffin's report and proceeded bravely to the frontier in spite of it. Some others failed to read it at all, for one reason or another, and thus ventured forth, unaware of the conditions that awaited them.

HERVEY PARKE

On March 21, 1821, Captain Hervey Parke left Camden, New York, on his way to the wilds of Michigan Territory. Parke had not seen Tiffin's 1815 report; he knew only that the public land surveys were under way there, and he had made up his mind to become a government land surveyor. Fortunately, Parke later wrote his memoirs from which we know the following about his adventures.¹⁰¹

Parke was not quite 31 years old when he walked the 500 miles from his home in New York, through part of Canada, to his destination in Michigan. He carried a knapsack heavily weighted with surveying equipment, and it took him "sixteen days faithful travel through mud and water, often knee deep" before he reached the Detroit River and crossed over it in a rowboat to the small city of Detroit.

From there Parke went "through the wilderness to the interior." He reached the village of Pontiac on June 1, 1821, and soon afterward met Horatio Ball, who had a contract for subdividing 10 townships of land between the Flint and Cass Rivers. Parke accompanied Ball on this survey.

They arrived at Flint River to find that heavy rains had so swollen the river that it was impossible to cross. They solved this problem by going up river where they "felled a suitable pine." After they had removed about 16 feet of it from the main body of the tree they shaped it into a crude canoe "digging out the same, so far as could be done with axes, and floated it down river and landed it on the north side where the city of Flint is now located." At that time, however, there was no city; there was but one log house, which belonged to Jack Smith, an Indian trader.

Joseph Wampler, the surveyor who had the contract to run the township lines, met Ball and Parke at Smith's trading house and furnished them with the necessary field notes. Almost immediately, Ball and Parke began their work "in town [ship] seven north, of range seven east." One week later the two surveying parties again met at Smith's trading house. Wampler's men had refused to continue the survey "on account of the suffering they had endured from the mosquitoes, both men and horses being weak from loss of blood and want of rest." Ball and Parke had to discontinue their work too, since the township lines had not been completed.

Early in the autumn, however, Wampler returned to finish his work. This also enabled Ball to complete his contract. It took two months, and, due to Ball's inexperience and the fact that the weather was not as warm as it had been when they first started their work in June, they had a hard time of it. Parke described it this way:¹⁰¹

We suffered both from hunger and cold. We had no tents, only an old second-hand tarpaulin, which had been laid aside as useless for hatchway service. In the absence of a kneading trough, our cook made use of this piece of canvas to mix his bread. This was unfortunate, for on our first visit to the trading-house, some swine, attracted by the adhering dough, nearly devoured and entirely destroyed it, and we had now no cover besides our blankets. Our provisions were inadequate; we were frequently reduced to a short allowance of only buggy

peas, and at one time, when weak from want of food, we found a wigwam where a squaw was cooking succotash, which she kindly divided with us. This occurred on the last day of our survey, while meandering the river. Closing our work on the line of the reserve at sunset and following up the river, forcing our way through thick beds of rushes knee high, at about nine o'clock we reached Smith's trading-house, so hungry from several days short allowance, that we took the potatoes from the kettle half boiled.

Parke Meets Tiffin

The surveyors finished their work on the last of December and went to Chillicothe, Ohio, to make their reports to the surveyor general. Parke had letters of recommendation from Governors Cass of Michigan and Clinton of New York, as well as one from Judge Wright, chief engineer of the Erie Canal. He presented these letters to Surveyor General Edward Tiffin and was promised future work as a government surveyor.

On the strength of Tiffin's promise of work, Parke returned to New York, gathered up his wife and daughter and, in May 1822, again set out for Michigan. He and his wife disposed of all their furniture and belongings except the few possessions they considered indispensable, including Parke's surveying equipment.

Return to Michigan

At that time, Hervey Parke was 32 years old. His worldly goods consisted of a borrowed cabin, a hand-hewn table and chairs, several trunks, the personal and household items he had brought with his family from New York, his surveying equipment, and \$8.50 in cash.¹⁰¹

For a time Parke worked at small surveying jobs and at teaching school. Then, in February 1823, he and John Mullett, a surveyor who lived in Detroit, decided to travel together to Chillicothe to arrange for surveying contracts. Between them they had two blankets, one pony, and one saddle.

They made a crude box sled out of a crockery crate and padded the inside of it with straw. Parke and Mullett then hitched the pony to the sled, climbed in and glided over the ice from Detroit to Sandusky, Ohio. There they abandoned the homemade sled and continued their journey on foot and horseback. Since there was only one pony and saddle, Parke and Mullett took turns riding. One of them rode a certain distance, dismounted, tied the pony to a convenient tree and proceeded on foot. The other man walked to the place where the pony was tied and mounted it. After a time he

passed his companion, rode on to the proper place and dismounted. He then took his turn at walking. They continued this ride-and-tie arrangement until they reached the surveyor general's office in Chillicothe.

Parke Appointed Deputy Surveyor

Surveyor General Edward Tiffin kept his word. He administered the oath of office to both Parke and Mullett and each received a contract. They were among the first surveyors appointed from Michigan. Always in the vanguard of civilization, they were true pioneers, as were their fellow surveyors Lucius Lyon and his brother Orson, plus Sylvester Sibley, Clark O. Ridsen, and Judge William Burt, among others.

When Parke began his public land surveying career, James Monroe was President of the United States, which had a population of fewer than 10 million people.¹ By the time he finished his last contract, John Tyler was President and the population had grown to more than 17 million.¹ During these years Parke surveyed in Iowa and Wisconsin, as well as throughout large areas of Michigan. He surveyed through blizzards, a cholera epidemic, and the Black Hawk War. He faced swamps, Indians, high prices, short rations, and bitter cold. And he rarely complained, although once, after a protracted snow storm left drifts up to 20 feet deep, he did mention that he found surveying in prairie country discouraging under those conditions. Parke, who was born in April 1790, lived to be nearly 90 years old. He died in Pontiac, Michigan, on October 3, 1879.¹⁰¹

A Battle and a Name

In 1825, or 1826, John Mullett and his crew were working near the banks of a nameless creek in a part of Michigan still inhabited by Indians. The Indians did not trust the surveyors and went to some effort to hinder them in their work.

Finally, one day, Edwin Baldwin, the packer, and Taylor, the cook, were alone in camp when suddenly two Indians appeared. One of them grabbed a camp kettle. The cook grabbed him and tried to get it back. The second Indian went to the aid of the first one, so the packer struck at him with a big handspike that was used as a fire poker. The battle grew hotter and one Indian fired his rifle. The shot missed, but the powder scorched Baldwin's clothing.

Soon Baldwin knocked his opponent out and rushed to help the cook, who was a small man with a crippled hand. He found Taylor knocked on the

ground with the Indian on top of him. The packer soon quieted that Indian, too.

When Mullett's party returned to camp, they found one Indian securely bound and the other unconscious. They decided it would not be wise to stay there and, the following morning, they turned the Indians loose, broke camp, and headed for home.

When they reached Parke's survey camp some 20 miles to the east, they told him what had happened. Fortunately, Parke continued his survey unmolested, and finished it in about 3 weeks. Mullett returned to his survey area a few weeks later. To commemorate the small but fierce battle that had taken place between the packer, the cook, and the two Indians, the surveyors henceforth called the creek near their camp "Battle Creek." And that, so the story goes, is how Battle Creek, Michigan, got its name.¹⁰¹

SURVEYS SOUTH OF TENNESSEE

In 1816, General Andrew Jackson wrote to President James Monroe to recommend the appointment of General John Coffee to the position of surveyor of the northern part of the lands south of the State of Tennessee. Following this, Coffee received the appointment as surveyor of all the public lands that are now included in Alabama.¹²⁹

Florida Cession

In 1819, Spain ceded both East and West Florida to the United States. Under the terms of the treaty, conflicting claims were settled, and the boundary between the two countries was defined as the line made by following the west bank of the Sabine River to the 32nd parallel, then north to the Red River, and along its course to longitude 100° W. of London. (The treaty also specifies this position as longitude 23° W. of Washington, so there was some uncertainty to this boundary location. The position was recognized as longitude 100° W. of Greenwich in separate acts of September 9, 1850, and June 5, 1858.) The boundary then ran due north to the Arkansas River and along its southern bank to the 42nd parallel, then along that parallel to the Pacific.³⁴ This Spanish cession and the various boundary adjustments involved added more than 46 million acres to the Public Domain.

Jackson Recommends Butler

In 1824, Colonel Robert A. Butler was appointed as surveyor of the public lands of Florida. The

appointment was made by President James Monroe at the request of General Andrew Jackson, Butler's commanding officer during the War of 1812. As surveyor general of Florida, Butler was to have "the same power and authority as by law appertained to the Surveyor South of the State of Tennessee."¹²⁹

Initial Point for Florida Surveys

One of Butler's first tasks was the selection of the initial point for the Florida public land surveys. Walton, Florida's lieutenant governor, asked that consideration be given the fact that the Federal Government had granted the Territory of Florida the southeast quarter of section 36, Township 1 North, Range 1 West, as a seat of government. Walton wanted to be sure the capitol building would be in the approximate center of that quarter section when the initial point was chosen. Butler complied with his wishes. The initial point for the Tallahassee Meridian and Base Line was about a quarter of a mile south and a quarter of a mile east of the site of the capitol. It was situated in a low area near the place where two streams joined.¹²⁹

Florida Public Land Surveys Begin

Benjamin Clements, a deputy surveyor, surveyed the principal meridian north to the northern boundary of the territory and south to the Gulf of Mexico. C. C. Stone established the base line eastward to the Atlantic.

Butler was instructed to appoint "one of your most skilful [sic] surveyors" to run the Tallahassee Base Line west to the Perdido River. Benjamin Clements and James Exum did this, and well. In the places where it has not been destroyed by man, more than a century and a half later, it can still be successfully recovered. This base line was extended west from the initial point to the west boundary of Range 18 West; from there it was offset north 6 miles and extended west from that point in order to avoid Choctawhatchee Bay and other bays and inlets of the Gulf of Mexico.¹²⁹

Early surveys based upon the Tallahassee Meridian were closed upon the St. Stephens Base Line as there was some doubt as to the position of the Florida-Alabama boundary. The state line, as originally surveyed by Andrew Ellicott in 1798, was later resurveyed and the public land surveys were closed against it. This resulted in some lands governed by the Tallahassee Meridian being administered in the State of Alabama.¹³⁸

The General Land Office in Washington instructed Robert Butler to survey 20 public land

townships in the vicinity of Tallahassee as soon as possible. Settlers were arriving and clearing land, and the emphasis in both Alabama and Florida was placed upon surveying and subdividing townships as quickly as possible in order to keep pace with the demand.

Butler's Term of Office

Butler served as surveyor general of Florida from 1824 until 1842, when President John Tyler appointed Valentine Conway to the position. At that time the office was relocated from Tallahassee to St. Augustine. When in 1845 Florida became a State, Robert Butler was again appointed surveyor general of Florida, serving until 1849, when Zachary Taylor became President.¹²⁹

Early Florida surveys proceeded well, in spite of the complications inherent in the surveying of such an area. Perhaps this was so because Butler chose his deputy surveyors with care; among them were Benjamin Clements, James W. Exum, and, particularly, Henry Washington.

Washington executed a number of surveys in Florida, including those of complex private claims. He also worked in Louisiana, and later in California. Everywhere that surveyors have retraced his lines, whether in Florida swamp or California desert, their conclusions have been unanimous: Henry Washington was one of the best.

Half-Mile Posts

Procedures developed in the States of Florida and Alabama were markedly similar—and markedly different from those in other public land areas. Both States share the unique existence of half-mile posts. These were established on exterior section lines and may or may not coincide with quarter corners used in the proper subdivision of the sections.¹³⁰

EAST FLORIDA DONATION ACT

Certain settlement laws were designed to attract population to the farthest flung territories of the United States. In order to encourage settlement in East Florida, which was desirable, especially from the standpoint of national defense, Congress passed the Act of August 4, 1842 (5 Stat. 502), which provided that any person who was the head of a household or any single man over the age of 18 years who had settled, or would settle within 1 year, on the land and live on it and improve it for 5 consecutive years would be entitled to 160 acres of public land.

SWAMP ACTS

During this same era, attention was also directed to the millions of acres of lands in the Mississippi Valley, which had been bypassed by settlers because of the danger of flooding. In the period prior to the Civil War, voices began to be raised in the interest of flood control on the Mississippi River. The ultimate result was the introduction of Federal aid for reclamation.

In 1848 the Land Commissioner recommended that swamplands along the Mississippi and in Florida be ceded to the States in which they were situated, on condition that the proceeds be applied to the reclamation of the lands. The economic benefits of such an action were pointed out, and the Federal Government responded by the passage of the Act of March 2, 1849 (9 Stat. 352), which granted to the State of Louisiana all its swamp and overflowed lands for the purpose of aiding in their reclamation. The Act of September 28, 1850 (9 Stat. 519), extended the grant to other public land States then part of the Union. The grant was extended to Oregon and Minnesota by the Act of March 12, 1860 (12 Stat. 3).

The swampland grants applied to all swamp and overflowed lands unappropriated at the dates of the granting acts, whose character at the time of the act would bring them within the provisions of the grant. These lands were surveyed as public lands and subject to classification at that time. One exception to the swampland laws is in the Arkansas Compromise Act of April 29, 1898 (30 Stat. 367; 43 U.S.C. 991). Under the terms of this act all right, title, and interest to the remaining unappropriated swamp and overflowed lands reverted to the Federal Government.

To bring land within the definition of the several swampland granting acts, the greater part of any quarter-quarter section or any lot must have been so swampy or subject to overflow during the planting, growing or harvesting season, in the majority of years at or near the date of the grant, as to be unfit for cultivation in any staple crop of the region in which it is located unless some artificial means of reclamation were provided. Surveys covering or relating to swamp and overflowed lands required a knowledge of the provisions of the swampland granting acts. The grants of swamplands within the borders of each State had reference only to the public land States then existing, and no State subsequently admitted acquired any rights under it.

The swampland grants took effect on the date of the passage of the act. However, the State's title to

the lands was inchoate until the lands were identified and title issued as provided by the act. The following table shows the acts and the date of their passage. It also shows the public land States that received grants under the terms of each act.

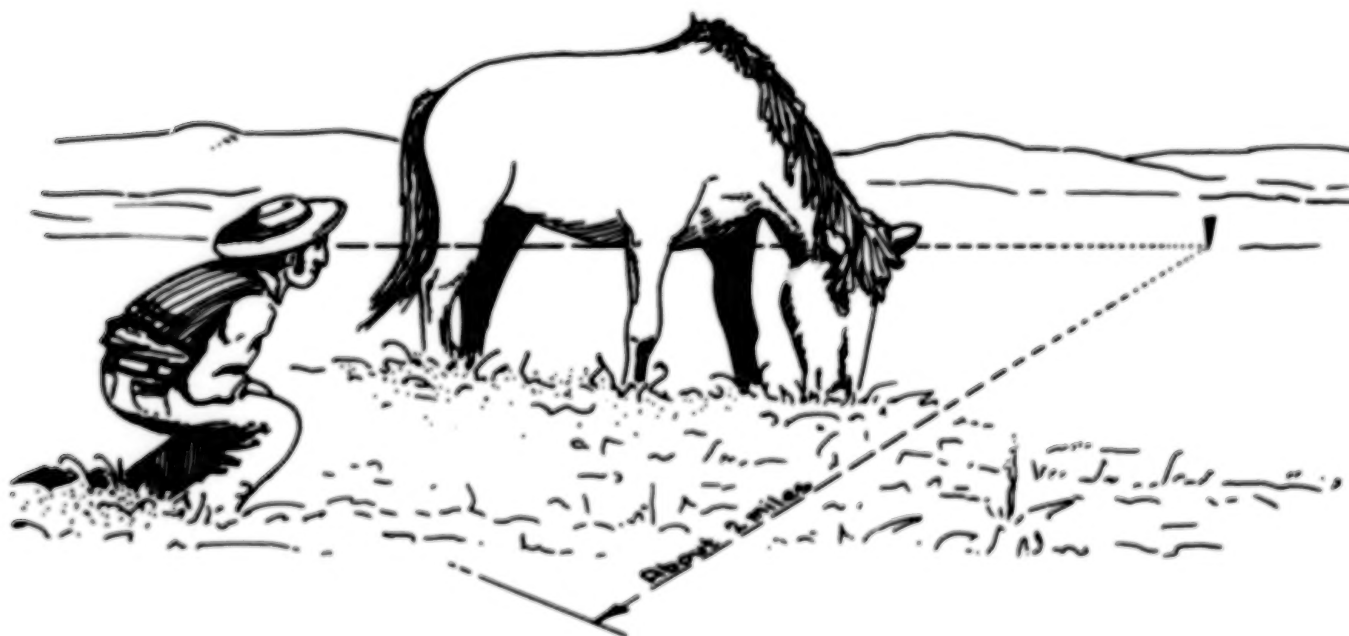
Acts	States
Louisiana Swamp Land Act of March 2, 1849 (9 Stat. 352)	Louisiana
Swamp Lands Act of September 28, 1850 (9 Stat. 519)	Alabama Arkansas* California Florida Illinois Indiana Iowa Michigan Mississippi Missouri Ohio Wisconsin
Swamp Lands Act of March 12, 1860 (12 Stat. 3)	Minnesota Oregon

*Under the terms of the Act of April 29, 1896 (the Arkansas Swamp Lands Compromise Act), Arkansas relinquished all right, title, and interest to the remaining unappropriated swamp and overflowed lands within its boundaries (43 U.S.C., sec. 987).

THE RED RIVER OF THE NORTH

In 1818, while Tiffin was still surveyor general, a boundary settlement with Great Britain gave a rich portion of the Red River Valley south of the 49th parallel to the United States.¹¹ Early settlers along the Red River north of the parallel surveyed land using the Indian measurement of 2 miles for the depth of a lot. They had found that the distance bounded by a horizontal line of sight made under the belly of a horse measured somewhere near 2 miles, if the land was level.¹²

The States were allowed optional methods of preparing lists of the subdivisions to be identified within the meaning of the acts granting swamp lands. In Alabama, Indiana, Louisiana, Michigan, Minnesota (except lands within Indian reservations), Mississippi, Ohio, and Wisconsin, the swampland lists are based on the survey field note record. In California, the swampland lists are based upon the representations of the survey plat. In Florida, Illinois, Iowa, Missouri, and Oregon, and within the Indian reservations in Minnesota, the swampland lists are based upon investigations and reports by representatives of the State and of the



Bureau of Land Management. These representatives utilize survey information in preparing their reports.¹³⁸

The fifteen public land States that did not receive swamp and overflowed lands under the acts granting such lands are: Alaska, Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, Utah, Washington, and Wyoming.

LUCIUS LYON

When he was about 21, Lucius Lyon became one of Michigan's rugged pioneer surveyors. Seven years later, on July 4, 1828, this soft-spoken bachelor from Vermont was aboard a steamer, on his way from Detroit to Green Bay. He had a contract to make the first official public land survey in what would soon be Wisconsin Territory.¹³² Lyon hired a canoe and paddlers at Green Bay and went to the Fox-Wisconsin portage. There, on July 19, he surveyed the 648-acre wedge-shaped parcel of land claimed by Augustine Grignon.

Two days later, Lyon began the survey of Prairie du Chien. In that area the French land claims were held by descendants of voyageurs and fur traders. Although the United States had granted deeds to these claims in the early 1820's, it was Lyon's surveys that established the official boundaries of the first privately owned land in Wisconsin. From Prairie du Chien, Lyon went to Galena, the heart of the lead mine region. He and Morgan L. Martin, a frontier lawyer, speculator, and politician, conducted a quick and unofficial survey that resulted in a (surprisingly accurate) map of the Wisconsin-Illinois lead country.

Although Lyon soon went back to Detroit, he returned to the lead country in 1830 to survey the Indian land ceded to the United States under the terms of the 1829 Treaty of Prairie du Chien. Other than fort locations, this land was the first Wisconsin land acquired by the United States.

Lucius Lyon and his brother Orson started the survey 10 miles north of the village of Chicago. They surveyed northwest to the blue mounds, east to Lake Mendota, northeast to the southernmost bay of Lake Puckaway, and north to Portage.

Wisconsin Surveys—Initial Point

In 1831 Lucius Lyon was appointed United States commissioner on the survey of the north boundary of the State of Illinois. He set a post and erected a mound of earth 6 feet square at the point where this boundary intersected the Fourth Principal Meridian. The Wisconsin public land

surveys were started from this point in 1831. Lyon surveyed 16 townships in southwestern Wisconsin during 1832 and 1833, thus opening what later became Wisconsin Territory to settlement.

When Lyon had completed the 16 townships called for in his contract, he left the field to learn that he had been chosen as the Democratic Party's candidate for congressional delegate from Michigan Territory. He was elected in July by the territorial legislature and left the lead country in the middle of June 1833. Although Lucius Lyon never returned to the lead country, his brother Orson remained a deputy surveyor and acted as agent for Lucius in the purchase of several thousand acres of land, including large holdings in Madison, Milwaukee, and Cassville.

Senator Lyon

In 1835 Lucius Lyon became one of Michigan's first two U.S. Senators. Four years later, he returned to Michigan to oversee his large investments—experimental sugar-beet farming, a salt well, a canal, and steamboats on the Grand River—and all failed. In the early 1840's, Lyon's mortgages came due at a time when land prices had dropped drastically. Lyon lost everything. He set about to return to his former job as a surveyor. Before he had found such work, however, he was elected to the U.S. House of Representatives.

Surveyor General Lyon

After that political duty, Lyon finally returned to his first job; he was appointed surveyor general for Indiana, Ohio, and Michigan. He accompanied survey crews into upper Michigan in 1846 to search for gold. Although they did not find gold, they did find what was, at that time, the largest known deposit of iron ore in America. Lyon's fortunes were on the upswing when he suddenly died in 1851.¹³²

As is true of most pioneer public land surveyors, there is little to commemorate Lucius Lyon—at least in the way of conventional commemoration. There are only his field books describing the distances he measured and the directions of his lines, the stakes he set, and the trees he blazed. His field books record accurate descriptions of the frontier of his day, and his work helped give the settlers who followed him security in the possession of their land.

CONGRESSIONAL ATTITUDE CHANGES

During the early 1800's, the attitude of Congress toward settlers on the public lands began to

undergo a subtle change. The importance of money from the sale of the land was giving way to an interest in encouraging settlement.² During these years a migration of optimistic, restless people began. They moved westward with everything they owned. The magnet that drew them was land. They searched for good farms and for the adventure and success that might be theirs on the American frontier.

The laws governing the sale of the public lands called for survey prior to settlement, but surveyors' lines sometimes ran through fields already being tilled. At first the people who took up land ahead of the surveys were looked upon as trespassers. Unauthorized settlers on the land of the Public Domain stopped being a big problem when Congress began to view them as brave pioneers rather than "squatters."

As a result of this change in attitude, the survey and sale of half-quarter sections was permitted, for the first time, under the Act of April 24, 1820. This allowed people of limited means to buy land at the minimum cash price of \$1.25 per acre. By the time this act was passed by Congress, about half of the Public Domain land in Alabama, Indiana, and Ohio was surveyed. The surveys had started in Arkansas, Louisiana, and Mississippi, and about a quarter of Missouri and Illinois had been surveyed.³⁰

Ten years later, the passage of the Act of May 29, 1830, made it illegal to obstruct the survey of the public lands, and called for the protection of the surveyors in the discharge of their official duties.

ABRAHAM LINCOLN

When Abraham Lincoln left Indiana on his way to Illinois in 1830, he followed the heavily traveled Buffalo Trace, and crossed White River on a ferry owned by a man named Harlan.¹⁰⁴ Lincoln served as captain in the Illinois Militia during the Black Hawk Indian Wars¹ and came home to New Salem and to a period of hard times in 1832. He was friendly and well liked, but there just were not many jobs available. He accepted the position of postmaster, even though the pay was meager. He made more friends, but he had had to resort to odd jobs to meet his expenses by the time he became acquainted with John Calhoun, the surveyor of Sangamon County.¹²²

Sangamon County was a large county in those years, and settlers created a need for surveys. Calhoun offered Lincoln a job, even though at that time Lincoln had no experience as a surveyor. Lincoln took the job and began studying with

single-minded purpose. Perhaps he recalled that his father had lost his family home in Kentucky because of uncertain land lines, and he realized the importance of the work.

Lincoln's Surveys

Lincoln was ready to begin surveying on his own by the end of 1833. The secondhand surveyor's compass he bought was one made by Rittenhouse and Company. It had two opposed leveling vials and an improved vernier. The Gunter's chain he used was only 33 feet long, perhaps because he was working in an area of heavy undergrowth.

The first record of a survey by Abraham Lincoln is dated January 6, 1834, just over a month before his 25th birthday. The work was done for Reason Shipley, who owned eight 80-acre parcels in Township 19 North, Range 7 West, Third Principal Meridian (now in Menard County, then in Sangamon County).

In the latter part of 1822, Deputy Surveyors D. Miller and A. Monday had surveyed the subdivisional lines of the township, placing stakes set in mounds at the section and quarter-section corners. Abe Lincoln probably used their field notes extensively in located their original points. Later, Lincoln surveyed another section for Shipley, making a total of about 1,280 acres.

The majority of Lincoln's surveys were in the same general area. For his work he was paid the rate set by law; he received \$2 for each half-quarter section he established. The records indicate that he did about 30 surveys, the last one in 1836—shortly after he had been admitted to the Illinois bar. Some of Lincoln's later work as a lawyer came to him as a direct result of his experience in surveying. For example, on January 6, 1859, a group of Illinois surveyors hired him to formulate a legal opinion for the correct method of dividing a section into quarters.

Lincoln's position as a surveyor also helped him to solve his financial problems and make a modest living. He proved himself to be an energetic, capable man by working hard and becoming a good surveyor. For more than 2 years, while he was in his 20's, Lincoln practiced not only the mathematics of surveying, but also the investigation and observation, the skillful examination of evidence, and the knowledge of land law required by this profession. Perhaps these characteristics influenced the people who set Lincoln on his political career by electing him to the Illinois General Assembly in 1836.¹²²

"A LAND-OFFICE BUSINESS"

In 1812, on the eve of war with Great Britain, the General Land Office was created. With its inauguration, administrative machinery that was to manage about a billion and a half acres that were stretched across the public land States came into being. This administrative machinery, headed by a commissioner, was eventually to handle the transfer (through sales and grants of various types to individuals, companies, states, and railroads) of two-thirds of this enormous area.

The commissioner, his assistant, the surveyors general (15 of them by 1880), the registers and receivers (52 of each by 1911), superintendents of public sales, an ever increasing number of clerks, deputy surveyors, and later, investigating agents, made the machinery run. For many years the people of the public land States were in much closer touch with the General Land Office than with any other Federal office of the United States. It was during this era of rapid and extensive business that a new phrase, a "land-office business," became a part of the American language. And everyone knew exactly what it meant.

Protection for surveyors in the execution of their duties was afforded by the Act of March 3, 1925 (R.S. 2413; 43 Stat. 1144; 43 U.S.C. 774).

Whenever the President is satisfied that forcible opposition has been offered, or is likely to be offered, to any surveyor or deputy surveyor in the discharge of his duties in surveying the public lands, it may be lawful for the President to order the marshal of the State or district, by himself or deputy, to attend such surveyor or deputy surveyor with sufficient force to protect such officer in the execution of his duty, and to remove force should any be offered.

Section 57 of the Criminal Code of 1909 restated the ancient Biblical admonishment against the removal of landmarks. On June 25, 1948 (Ch. 645, 62 Stat. 789; 18 U.S.C. 1858), the wording was modified to read:

Whoever willfully destroys, defaces, changes, or removes to another place any section corner, quarter-section corner, or meander post, on any Government line of survey, or willfully cuts down any witness tree or any tree blazed to mark the line of a Government survey, or willfully defaces, changes, or removes any monument or bench mark of any Government survey, shall be fined not more than \$250 or imprisoned not more than six months, or both.

Lincoln Survey Retraced

In 1834, Abraham Lincoln had laid out the original 15 blocks of a small Mississippi River town called New Boston, Illinois. In later years, the town grew into a disordered puzzle of streets meeting the original streets at unorthodox curves and angles. For many years people speculated about the "crooked" original survey. John B. Freund, a registered professional engineer and land surveyor from Illinois, and William Gordon, a survey party chief, also speculated about it. So, some 130 years after Lincoln completed his survey, they decided to retrace Lincoln's steps to see why he surveyed it the way he did.⁷²

They discovered that Lincoln had used perfectly acceptable surveying practices, and that it was only subsequent events that caused his streets to appear to be crooked. Lincoln used the Mississippi River as a boundary line, a common practice in the early 1830's. His lines, if retraced

from the river, are quite straight and true, considering his lack of modern equipment. As the area around the town was surveyed into townships and ranges using the cardinal directions instead of the curve of the river, however, the resulting roads and streets were connected to the old streets of the town in such a way that Lincoln's surveyed lines appear crooked and angular.⁷²

IRA COOK

In the late summer of 1849, Colonel John Evans received a contract to subdivide 10 townships in Iowa. He sold a half interest in the contract to Ira Cook, and they made plans to begin the survey.¹⁰⁰ Even though there were thousands of settlers in Iowa several years before that,² their contract lay far beyond the populated area. They knew the survey would take quite some time, so they planned accordingly.

In relating his experiences nearly 50 years later, Ira Cook described the outfit they assembled as being a tent, "... the simplest necessities of food and clothing. A barrel or two of salt pork, flour in barrels, navy beans, with sugar, coffee, salt and pepper. ... For bedding we had rubber blankets, buffalo robes, and heavy woolen blankets. With these we could keep both warm and dry."¹⁰⁰ Their survey party consisted of 11 men, because they used two instruments. In addition to the instrument men there were four chainmen, two axemen or mound builders, two teamsters who also acted as flagmen, and a cook.

It took them 2 weeks to reach the land they were to survey. The "numerous branches of the Grand and Missouri Platte" slowed them up considerably. Occasionally, they found two large cottonwood trees on opposite banks of the streams. They cut them down in such a way that they met and overlapped to form a foot bridge. They then unloaded the wagon, carried everything across, swam the horses over, fastened the axles and wheels of the wagon to the box so they would float, and floated the wagon to the other side. When the wagon reached the other side, they hitched the horses to the wagon tongue. As the men lifted and the horses pulled, the wagon was pulled onto the river bank. Then they set the axles and wheels for land travel, reloaded the wagon, and started out again.

If it was late by the time they completed one of these crossings, they ate cold food, drank hot coffee, grabbed their blankets, and hunted a soft place on the ground to spend the night. When they reached their contract area, they started work each morning as soon as they could see. They often worked until dark and then hiked back to camp.

End of the Contract

Ira Cook and his crew finished the contract in January 1850. Because there were people living along the Missouri, they went south so that they might sooner reach some settlement. By the time they reached the Platte River, they were accustomed to cold weather and were not surprised when they found the ground so frozen they could not drive the tent stakes. There was no timber for shelter, and few scattered trees to use for firewood. They used the wagon for a windbreak and slept with their bedrolls pulled close to the fire. They had no idea of the actual temperature until they reached a settlement in Gentry County, Missouri, the next day. They were told that the thermometer had registered 31° below zero the night before.

Solar Compass

For several months in 1851, Cook and his party surveyed in the swamps and heavy timber between the Wisconsin and Wolf Rivers, on the divide between the Mississippi River and the Great Lakes. Because Cook wrote of their inability to see the sun in some places, we know they must have been using a solar compass. The survey soon took them into places that were impassable for the wagon. They packed the camp equipment on the horses, and traveled that way as far as they could. When the horses could not go any farther, the men carried what they could on their backs. The farther they went, the lighter their load grew, as their rations of food shrank. Finally, for a day and a half, they subsisted on salt pork and coffee.

1852-53 Survey

From September 1852 until just after the New Year, 1853, Cook's 11-man survey party subdivided 10 townships in a part of Iowa that lay well beyond the limits of white settlements. During those 4 months they had not one word from the world outside their camp. They did not even know who had been elected President of the United States in November.

Snowstorm

On their way back to civilization, Cook's party carried provisions for 3 days. It should have been enough; it should not have taken that long to reach the squatter's cabin where they had cached some of their food. However, a snowstorm changed everything. By 9 a.m. on the 2nd day, it was snowing so hard that they could not see their way, so they pulled down into some timber, made camp, and agreed to ration what was left of the food. Two days later they dug themselves out of the snow and crossed the river on the ice. The men formed lines and broke a trail for the horses and wagon through the knee-deep snow. It was slow, exhausting travel. On the morning of the 7th day they left the wagon behind in order to save the horses. That day the sun finally came out. It served to warm their spirits as it melted some of the snow. At 4 a.m. on the 8th day,

... the cook made a pot of strong coffee and distributed the very last of our food, which consisted of one small biscuit (then five days old) and one very small spoonful of cold boiled beans to each, and long before daylight we were tramping over the prairie by moonlight, breaking the frozen crust of the snow. ...

Later that morning Ira Cook and his men saw the cabin in the distance. Although the men suffered no ill effects, Cook must have decided to quit while he was ahead; it was his last contract as a deputy surveyor.¹⁰⁰

HAPPY AND UNHAPPY ENDINGS

Alex Anderson's Field Notes

Not all of the men on early surveys ended their careers on such a happy note. The abrupt termination of employment of one of the men on Alex Anderson's survey crew was duly recorded in the field notes. The survey line was near Sioux City, and the 1852 field notes read: "Ivy Johnson, one of my men, was accidentally shot yesterday and died almost instantly." The field note record continues with bearings and distances and includes a "tie" to Ivy Johnson's grave.¹⁴

Daniel G. Major's Field Notes

Then there was Daniel G. Major's survey party, which worked westward on the survey of the Oregon-California boundary in 1869. Major used many descriptive words about the brush his party encountered. In his field notes some of it is called "thick," "dense," "tangled," and "difficult"; some of it is termed "heavy," "matted," "troublesome," and "impassable." When they had surveyed about 168 miles through the brushland, he noted that they had to descend the "fearfully brushy" side of a mountain and cross the Steamboat Branch of Applegate Creek. As the ill-tempered survey party rested beside the stream, the men noticed "excellent gold indications." Forgetting about the brush, they successfully panned gold for an hour or so. And, when they continued on their way, their spirits were lighter and their pockets were heavy with gold.

Nathan Butler's Reminiscences

Nathan Butler had vivid memories of his public land surveys in Minnesota. Among the strongest of his recollections were those of some things that almost happened, but somehow did not.⁹⁸ Butler's first experience in public land surveying occurred in 1861 when he "assisted J. W. Meyers in running the township lines between the first and second standard parallels and the fifth and sixth guide meridians, in the area that is now Murray and Pipestone Counties." Because, at that time the

population around Lake Shetek, which was near the head of the Des Moines River, consisted of about half a dozen settlers and many Indians, the surveyors were somewhat concerned for their safety.

The Indians did not bother the surveyors, however; they just sat on the hills and watched them all day, "evidently anxious to see what we were doing; and we would sit up nights and watch them, just as anxious to know what they were doing or wanted to do," noted Butler.

Later that year, in the same area, the Indians did not steal the surveyors' horses, although they tried. The surveyors were careful; they hauled the wagon close to the front of the tent and tied the horses fast to the wagon and "to make the thing doubly safe, we tied a picket rope to each horse's forefoot and the other end of the rope to the teamster lying in the tent. Within ten minutes of the time when we extinguished the light, one of the horses started and hauled the teamster out of his blankets." The halter rope had been untied, but the picket rope had save the horse from Indian capture.

The next year, 1862, Butler worked with George B. Wright and Isaac A. Banker. Although they were not attacked by Indians, there were rumors of trouble, so the surveyors stayed at Fort Ripley. Once, a "false alarm about midnight turned out everyone in the fort. Men, women, and children could be seen running from one building to another in their night clothes. Had the Indians made an attack they might have killed the greater part of us, for we could not dare to shoot on account of the danger of killing our own people."

One of Butler's most interesting comments about his work reads:⁹⁹

In the winter of 1872-3, I was surveying township 57 [north], range 23 [west]. On the east line of that township the local attraction was so great that the magnetic needle was of no use. I had to use the solar compass. There were millions of dollars of the best kind of iron ore under my feet, and I did not know it. I thought it was drift that had come down from the Mesabi Range.

WILLIAM A. BURT

William Austin Burt was born in Massachusetts on June 13, 1792. He grew up in New York State, where he spent much time studying such subjects as geometry, navigation, and surveying. Although his formal schooling was limited to only a few

REMOVE NOT THE ANCIENT LANDMARK

During the early summer of 1931 some Montana State Highway Department employees were clearing a highway right of way when they noticed a slab of rock about 14 by 24 inches in size. It was firmly imbedded in the ground and bore the markings:

2 HES

98

The workmen pondered about the possible meaning of the cryptic inscription. Finally, they decided that it was a grave stone marking the burial place of two men ("hes") who had died in 1898.

Then they notified the proper authorities that it would be necessary to remove the remains from the right of way. In due time, the coroner, a deputy sheriff, and a Highway Department official proceeded to the burial site and began to dig.

When several hours of hard labor failed to reveal the remains of the two dead men, it was decided that the earth had somehow slipped and the unfound remains must be further up on the hillside and thus out of the right of way.

About this time the matter came to the attention of a more knowledgeable official. He sent a copy of a memorandum about it to J. Scott Harrison, assistant supervisor of surveys for Montana, so that he might know how Corner No. 2 of Homestead Entry Survey No. 98 came to be destroyed. (Memorandum from A. A. Abbott to J. Scott Harrison, June 22, 1931)

weeks, these subjects along with mechanics fascinated him.²⁹

Before Burt became a United States deputy surveyor, he had been a district and county surveyor in Michigan and had held a wide variety of other jobs: soldier in the War of 1812, businessman, mill builder, justice of the peace, school inspector, postmaster, and Michigan Territory legislature member. It was because he was also an associate district judge that "Judge" is the title by which he was known during his years as a deputy surveyor.³⁰

Burt, who received his first public land surveying contract in 1833,²⁹ taught surveying to all five of his sons. BLM records show that the Burt clan surveyed enormous areas of land in the upper peninsula of Michigan, and also in Wisconsin and Iowa. These surveys cover about 25 years—from the early 1830's until about 1858.

The Solar Compass

While William Burt surveyed public lands in northern Michigan, he found he had great difficulty because of the deviation of the needle of the magnetic compass. Because he discovered what was causing its erratic behavior, he has been credited with the discovery of iron ore in the region.²⁹ Yet knowing what caused the problem did not solve it, however. Burt fretted about the wandering needle until he came up with an idea that evolved into the solar compass. Burt constructed a model of his invention in 1835 in order to test its principles, and later that year he had William J. Young, an instrument maker in Philadelphia, make the first working solar compass. Burt received the patent for it in 1836. In recognition of

its enormous value, he was awarded a premium of all of \$20 and a Scots' Legacy medal by the scientific committee of the Franklin Institute of Philadelphia.

The Test

For a time after the invention of the solar compass, it was primarily used as an auxiliary to the ordinary compass. Gradually, however, it came into more widespread use. Because deputy surveyors of those days made no notes of the instruments they used, it is impossible to know exactly when and where the solar compass was first used in public land surveys, but it was probably soon after it was patented.

On March 3, 1849, Congress passed the bill that authorized the survey of the Iowa-Minnesota boundary. Over a period of time, more than \$30,000 was appropriated to defray the expenses of this survey, which was made by Captain Andrew Talcott of the Topographical Bureau in 1852. In order to test the practicality of his solar compass as the primary instrument of such a survey, Judge Burt sent Captain James M. Marsh of Dubuque, Iowa, to run this line with a solar compass ahead of the government party. Marsh's line proved to be perfectly correct—a fact that led to much discussion afterward since the survey would have cost about \$6,500 had it been done by Marsh, using the solar compass, under a regular government survey contract at \$25 per mile.³⁰

Burt's Recommendations

The publication of a book in the 1850's added authorship to Judge Burt's credits. It was entitled

"A Key to Solar Compass, and Surveyor's Companion," and it included a list of tents and other camp equipment, clothing, bedding, provisions, pack animals and gear, and surveying instruments that Burt had found were needed by a six-man surveying party for a 4-month survey of the public lands. Experience apparently had taught Burt that things did not always go well, because he listed as requirements such things as "4 papers of 3 oz. tacks for nailing boots," and ". . . needles, awls, thread, twine, small cord, & c." He also made a point of mentioning that the 2 dozen boxes of matches were to be of the "best kind," and that the camp kettles should be riveted ". . . where they would be likely to separate when exposed to the fire."⁸

Survey Examinations

William Burt was not only a gifted man; he was an honest one. In 1849, the same year that the Interior Department was created, Judge Burt was named examiner for some of the surveys in Michigan. Two of his sons had surveyed in the area, and he knew all the surveyors. When Burt found several of the surveys erroneous or fraudulent, including one for which he had signed as security, he reported the fraud at substantial cost to himself. He later made good on the contract by surveying it.¹²

MAGNETIC COMPASS PROHIBITED

Burt's solar compass was officially recommended as early as 1850, but it was not required by regulations until 1890. The "Manual of Surveying Instructions" issued that year prohibited the use of the magnetic needle except in subdividing and meandering, and then only if the locality was known to be free of local magnetic attraction. The manual issued 4 years later required that all surveys of the public lands of the United States, embracing all classes of lines, be made with reference to the true meridian, independent of the magnetic needle. The 1902 Manual was even stronger in denouncing the use of the magnetic compass. In 1919, a booklet was issued to surveyors. It contained the first part of the manual that was published in its entirety in 1930. This 1919 publication unqualifiedly prohibited the use of the

needle compass as a means of determining the direction of lines of the public land surveys.¹³⁸

Nathan Butler, who surveyed the public lands in Minnesota for 30 years (from 1861 until the winter of 1890-91), wrote this about the solar compass:⁹⁸

The solar compass, invented by William A. Burt of Detroit, Mich., is the most convenient and efficient instrument ever used in surveying government lands. It can only be used when the sun shines, but it can be set up, and the course can be determined with it, without reference to any back-sights or other surrounding object, and in spite of any local magnetic attraction. When kept in perfect adjustment and properly manipulated, it will do perfect work; but if it gets a little out of adjustment, it will throw a line out of course worse than any other instrument. It consists of a common railroad compass with a full vernier. To the vernier plate is attached the latitude arc, with a limb or radius of five or six inches in length, according to the size of the compass. In the center, at a right angle to this limb, is a socket an inch and a half long and three eighths in diameter, to receive the polar axis of the instrument. On this polar axis is another limb, bearing the declination arc, on which is turned off the declination of the sun.

Butler explained exactly how the solar compass works and concluded by stating:⁹⁹

The solar compass has the reputation, among a certain class of men, of being imperfect and unreliable. It has done poor work, no doubt, but that was not the fault of the compass,—rather of the man who was using it.

THE SOLAR ATTACHMENT

In 1880, in Colorado, another deputy United States surveyor, Benjamin H. Smith, developed the telescopic solar attachment for an engineer's transit. It was the prototype of the modern solar attachment. The instrument now in use owes much to the dedicated efforts of Arthur D. Kidder, who was for many years the associate supervisor of surveys in the General Land Office. In cooperation with respected instrument makers, Kidder conducted studies that resulted in improvements in the solar transit.

THE FAR WEST

THE RIVER OF THE WEST

As early as 10 years prior to the Revolutionary War, Major Robert Rogers, commander of an upper Mississippi Valley English post, requested permission from King George III to send an exploration party to the Pacific Ocean by way of a river "called by the Indians Ouragon."³ No such party was ever sent. The river called "Ouragon," "Origan," "Oregon," or "Oregon" remained a legend—the mysterious "River of the West"—until an American, Captain Robert Gray, sailed into its mouth on May 11, 1792. Although the journal kept by Captain Gray has been lost, the one kept by John Boit, his fifth officer, has been preserved. It tells of the discovery of the river and that it was named "Columbia" in honor of Gray's ship.

When Lewis and Clark reached the mouth of the Columbia River on a bleak November day in 1805, they proved that travel overland from the East was possible. They spent the winter about 6 miles southwest of the point where John Astor's party later set up a fur trading post in 1811.

As a result of the War of 1812, the British took command of Astor's Post (Astoria) and held it until 1818, when it was returned to the United States. However, it remained under the domination of the British Hudson's Bay Company, whose headquarters was moved up river to Fort Vancouver (Washington) in 1824.³

In 1831, the first permanent Indian reservation, called Indian Territory, was established on public lands west of Iowa, Missouri, and Arkansas—and the survey of Louisiana was begun.¹ It was many years before the Indians left much of the vast area of the Louisiana Purchase and the Floridas, years before these lands were surveyed and settled, yet Americans pushed on, always searching for new land. Millions of rich acres in Minnesota, Iowa, and the other Prairie States remained unsettled. And, in the South, the most productive cotton land in the world went begging while restless Americans followed the trail tramped out by the mountain men and used by the missionaries—the trail to Oregon.

DREAMS OF EMPIRE

Men other than Americans also dreamed of empires. In 1834, Johann August Sutter left his native Switzerland (as well as his wife and children and his unpaid debts), and sailed aboard the

square-rigged *Esperance* when it left Havre, France, on its maiden voyage to New York.¹⁰ In 1838, about the time the surveys in Iowa and Wisconsin were started, Sutter followed the Oregon Trail to Fort Vancouver, on the Columbia River, and from there he sailed to Honolulu.

While there, Sutter arranged for a group of Hawaiian workmen to be sent to meet him at San Francisco Bay when he sailed back to California. These "Kanakas" were part of his plan to build a grand and powerful place for himself to live. Mexican Governor Alvarado conferred Mexican citizenship on Sutter and gave him 11 square leagues of land wherever he chose to establish his colony. Sutter chose the Sacramento Valley, near the mouth of the American River.

Soon, houses, a tannery, a gristmill, and a winery were built. Sutter's men drained and cultivated land. Crops and vines were planted; Sutter acquired cattle and horses. Before long, Governor Alvarado's successor, Michel Torena, granted Sutter enough land to increase his holdings to 33 square leagues. Within a few years Sutter had built a large fort and purchased the Russian claim to land in northern California.¹⁷ All this was to be doomed, a few years later, by an event that might have meant still greater riches.

THE GREAT EMIGRATION

In 1842, the East Florida Donation Act was passed. It granted a quarter section of public land in eastern Florida to any man who settled in the part of the state occupied by hostile Indians. That same year, Dr. John McLoughlin, chief factor of the Columbia River Department of the Hudson's Bay Company, gave the name "Oregon City" to the small village at "the falls of the Willamette." He had the town platted by an American recently arrived with the first large group of settlers. The man was Sidney Walter Moss, a stone cutter,²¹ who was chosen to do the survey for a very simple reason: Moss owned a pocket compass.³

The settlers who reached the Willamette Valley the following year, 1843, made up the body known as the Great Emigration. It was called that not only because of its size, which was without precedent, but also because of the number of its members who were unusually able, and who became leaders among the Americans in the Oregon country.¹⁷ The wagons of the Great Emigration assembled near

THE HOMESTEAD ACT

In 1860, Abraham Lincoln received a patent for 160 acres of public land for his services in the Black Hawk Indian War. In November of that year he was elected President of the United States. Shortly afterward, three new surveying districts were established, and surveys began in Colorado, the Dakotas, and Nevada.

On April 25, 1862, the 50th anniversary of the founding of the General Land Office was celebrated. Less than one month later, on May 20, 1862, Congress passed the Homestead Act, which went into effect on the same day President Lincoln issued his Emancipation Proclamation—January 1, 1863.

The Homestead Act fairly shone with generous western spirit. To acquire a patent to 160 acres of public land, only residence, cultivation, and some improvement upon it was required. After 5 consecutive years, the homesteader could apply for and receive a patent to the land for the cost of the \$15 filing fee. If he preferred, the homesteader could, after 6 months, purchase the land at the rate under which it was held, \$1.25 or \$2.50 per acre. Homesteading was open to anyone who was the head of a household or 21 years of age, and who was or intended to become a citizen.

Homesteading was not permitted on unsurveyed lands. In spite of previous preemption laws, and the lack of a positive prohibition of it, homesteading on land that had not been surveyed was not legal until 1880.

Independence, Missouri, in early May, and the wagon train set out for Oregon at the end of the month. Peter H. Burnett, later to become the first governor of California, was chosen captain and James W. Nesmith, later a U.S. Senator from Oregon, was the orderly sergeant.

Soon the company divided into two factions—those who had cattle and those who did not. Those without cattle did not want to move so slowly and to have to stand guard over the livestock. Unable to resolve the problem, Peter Burnett resigned his post. Those pioneers without cattle chose William Martin as their captain and moved on.

Those pioneers with livestock eventually chose Jesse Applegate as their leader. This group formed itself into what became known as the "cow column," and fell in behind.¹⁷

Jesse Applegate

Jesse Applegate, the leader of the cow column, was born in July 1811 in Kentucky. He and his older brothers, Charles and Lindsey, left there with their parents in 1820. They settled on a farm in the Osage Valley, not far from St. Louis, Missouri. When adults, Charles and Lindsey each had families with 6 children. Jesse chose to work as a clerk in the office of the surveyor general of Missouri at St. Louis, eventually becoming a deputy surveyor there. Later, he too, married and had 13 children. All three Applegate brothers and their families were part of the Great Emigration as it crossed the Great Plains; they all settled first in an area later known as Polk County. Then, in 1849, they moved to the southwestern Oregon area they called Yoncalla. Although the brothers were prominent

early Oregonians, it was Jesse who became a noted pioneer politician.

In 1844, Jesse Applegate did what was probably the first of his many survey jobs in Oregon. He was given the task of replatting Oregon City, and making it larger than the first, or Moss, survey. Because he did not have a regular surveyor's chain at the time, he used a rope 4 rods long. The length of the rope varied due to the dampness often encountered in the Willamette Valley, which accounts for the none-too-regular size of Oregon City lots.³ Upon completion of the Applegate survey, the legislature of the newly formed provisional government granted Oregon City a charter, making it the first town west of the Missouri River to be incorporated. It was still the only seat of American government on the Pacific Coast in 1850, when San Francisco was platted. Because of this, the original plat of the City of San Francisco is filed in the office of the Clackamas County clerk in Oregon City.³

The Oregon Compromise

In 1846 Jesse and Lindsey Applegate went with Levi Scott and 12 other men on an expedition to locate and blaze a trail that would provide access to western Oregon by way of a southern route. The trail they opened was called the Scott-Applegate Trail.

Some of the emigrants who started for the contested Oregon country the year the Scott-Applegate Trail was opened found, upon their arrival, that a treaty making Oregon part of the United States had been signed. The compromise boundary line followed the 49th parallel to the Gulf



Josiah Meigs, appointed surveyor general of all public lands east of the Mississippi River in 1810, exchanged positions with Edward Tiffin in 1814.

of Georgia, continued through the Strait of Juan de Fuca, and allowed Vancouver Island to remain a British possession. It was the peaceful end to the 1844 Democratic Party's warlike political slogan, "Fifty-four forty[54° 40'] or fight."¹⁷

THE SOUTHWEST

Also in 1846, the frictions that existed between the United States and Mexico grew into the Mexican War. One of the frictions was that Mexico was angered when Texas, having asked to join the Union, was annexed at the end of 1845 and became the 28th U.S. state. The war actually ended late in 1847, but the treaty establishing the Texas-Mexico boundary at the Rio Grande was not signed until 1848.¹⁴⁴

Treaty of Guadalupe-Hidalgo

Under the terms of the treaty, the Treaty of Guadalupe Hidalgo, Mexico ceded a vast territory in the Southwest, and the United States gained more than 334 million acres in public lands. This included the present states of California, Nevada, and Utah, as well as parts of Arizona, New Mexico, Colorado, and Wyoming.

Texas Purchase

The State of Texas, which retained title to its unoccupied land, was not a public land state. In 1850, however, a large area north and west of the present Texas boundary was purchased from Texas by the United States. This purchase, which

added more than 78 million acres to the public lands, included parts of New Mexico, Colorado, Wyoming, Kansas, and Oklahoma.¹⁵



Edward Tiffin was the first commissioner of the General Land Office. In 1814 he became the surveyor general of the public lands east of the Mississippi River, and Josiah Meigs became the second commissioner of the GLO.

Gadsden Purchase

In 1853, the Gadsden Purchase added another 18 million acres of public land to the United States. The area became the extreme southwest part of New Mexico and the southern part of Arizona. This part of the United States-Mexico boundary line was run and marked in 1855.³⁴

The Mormon Trail

Just before the final battles of the Mexican War were fought, the Mormons—who had suffered much persecution in Illinois and Missouri—made a

long westward trek in search of a new Zion where they hoped to find religious freedom. When they reached the Salt Lake Valley, Brigham Young told his followers that they had found "The Place." Afterward, the route of the Pioneers, as they called themselves, was known as the Mormon Trail, and was traveled by thousands of other emigrants. About 3 months after the Pioneers began their journey, another group of about 2,000 Mormons left their winter quarters on the west bank of the Missouri. This caravan consisted of 566 wagons and large herds of livestock. With its arrival in September 1847, a colony of nearly 3,000 people had settled at Salt Lake.¹⁷

Gold Rush to Sutter's Mill

In that same winter, 1847, Johann August Sutter needed lumber so he decided to build a sawmill. One of his employees was James W. Marshall, a carpenter, wheelwright, and general handyman. It was Marshall who chose the site for the mill, which was built about 45 miles east of Sacramento, at a point called Coloma. It was a good mill, but a gravel bar caused water to back up behind the wheel and stop it from turning. The tailrace had to be deepened and, as this was being done, in January 1848, Marshall looked down into the water and saw a glittering rock in the gravel at his feet. That glittering golden nugget spelled ruin for land-thirsty Sutter,¹⁷ who, at the end of the Mexican War, claimed more land than any other one person in the Union.¹⁰

By the time the treaty with Mexico was signed, Sutter's estate was being invaded and destroyed by people flocking to California in the wake of the discovery of gold. At one time, Sutter even claimed the land upon which San Francisco was built—all but a strip along the sea, which belonged to the Franciscan Mission. He also claimed the land upon which many other towns, including Sacramento, were built. He had paid the Russians for their vast claim and that land, too, was subsequently occupied by others.

The value of the gold taken from land Sutter claimed he owned was incalculable. When his roads, bridges, ditches, and watering places were taken over and used by the public, he felt he should be reimbursed for all these things. The difficulty lay in deciding just who should pay, and how much. It was a question of not one, but many thousands of lawsuits against many thousands of individuals and hundreds of towns and cities, as well as the State of California. Sutter thought that he also might sue the United States. There simply was no



A copy of part of the plat for the town of New Boston. It is situated on fractional section 31 and the southwest quarter of section 32 in T. 14., R. 5 W., in Illinois. The original plat is in the Mercer County Records Office, Aledo, Illinois.



Abraham Lincoln, surveyor.

way to obtain judgments against all the people and governments Sutter believed owed him money.

A California judge named Thompson was able to obtain a life pension of \$3,000 a year from the State of California for Sutter—the man who, for a while, had thought of himself as the richest man in America. Even so, most of Sutter's pension went to unscrupulous people who said they would help him with "his case." Beginning in the 1860's, Sutter made various petitions to the United States. Congress did not act on his case and he died 2 decades later, on June 17, 1880, a penniless, demented old man.¹⁰

MINING FRONTIERS

The discovery of gold in California changed the course of settlement in the United States, and, with the tide of settlement, came the need for surveys. Miners from all over the world found their way into the California mining area almost overnight. The

hordes of people who made up the Gold Rush of 1849 were, collectively and individually, trespassers on the public lands of the United States. All they thought of was the gold, and they considered it to be theirs for the taking.

Because of this prevalent attitude, the settlements based upon mining were not at all like the more orderly westward movement of trappers and farmers. The mining frontier followed a series of new finds, each of which set the miners off in a new direction to another remote area. For many of them, first came the rush, and then disillusionment. If there was enough precious metal—silver or gold or whatever—a roaring mining town grew and prospered. At least the gamblers and saloons prospered. Then, as happened in California in the late 1850's, the mines gave out. About the time a town realized it must rid itself of the outlaw element that seemed to follow the miners, it was on its way to becoming a ghost town, unless its residents

knew the real treasure, which was, more often than not, the land.

As the easiest mining ended in California, tales of precious minerals in Colorado lured the miners there. Or to Nevada. Or to parts of Oregon and Idaho. Later, Montana and the Black Hills of South Dakota beckoned. Later still was the rush to the Yukon.

CREATION OF THE DEPARTMENT OF THE INTERIOR

In 1849, in the face of this, the General Land Office was transferred from the jurisdiction of the Treasury Department to the Department of the Interior, which had just been created. There was no major change in the responsibility of the GLO,

The 11th Section of the act of Congress, approved Feb. 11, 1805, prescribing rules for the subdivision of sections of land within the United States system of surveys, standing ever fresh, in my opinion, is binding on the respective purchasers of different parts of the same section, and furnishes the true rule for Surveyors in establishing lines between them— That law, being in force at the time each became a purchaser, becomes a condition of the purchase—

And, by that law, I think the true rule for dividing into quarters, any interior section, or less than whole is not fractional, is to run straight lines through the section from the opposite quarter section corners, finding the point where such straight lines cross, or intersect each other, on the middle, or center of the section—

Now, perhaps quite all the original survey, as to some extent, previous, may be some of the details, long, greatly so— In the latter, it is obvious that a (now) square (more of course than the above, might be adopted; but as error is infinitely minor, perhaps no better angle rule can be prescribed.

*All that wants I think the above has been prescribed by the competent authority—
Springfield, Jan. 6, 1859. Abraham Lincoln*

WILLAMETTE STONE STATE PARK

THIS TRAIL LEADS TO THE WILLAMETTE STONE, THE SURVEYORS' MONUMENT AT THE INTERSECTION OF THE WILLAMETTE BASE LINE AND THE WILLAMETTE MERIDIAN. ALL THE LANDS OF OREGON WERE SECTIONIZED FROM THESE GUIDE LINES. THE MARK WAS ESTABLISHED ON JUNE 4, 1851, BY JOHN R. PRESTON, FIRST SURVEYOR GENERAL OF OREGON. THE ESTABLISHMENT OF THIS STONE WAS THE START OF THE SECTIONIZING OF THE PUBLIC DOMAIN ON THE NORTH PACIFIC COAST AND THE MONUMENT IS OF PARTICULAR INTEREST TO ALL SURVEYORS AND ABSTRACTORS. ITS GEOGRAPHIC POSITION IS: 45°31'10.831" IN LATITUDE AND 122°44'33.551" IN LONGITUDE.

This sign, beside Skyline Boulevard in Portland, Oregon, marks the trail to Willamette Stone State Park.

however. It continued to be organized according to functions. Of its nine main organizational functions, the foremost were public lands, surveys, and private land claims.¹

PRIVATE CLAIMS

As the surveys extended into lands that had recently come under American control, the GLO and the Federal courts, as well as the surveyors, had to face the problem presented by grants of land made by the previous governments of the areas gained from Great Britain, France, Spain, and Mexico.

These grants extended in size from city lots in such places as Detroit and New Orleans, to grants of a few thousand acres, to Louisiana colonization grants of 200,000 to 700,000 acres, to the enormous Forbes grant of nearly 1.5 million acres in Florida.¹⁵

Systems of Measurement

The land laws and the systems of measuring the grants of the French, Spanish, and Mexican governments were very different from those of England. The land grants of the French crown usually were described in terms of the "arpent," and Spanish and Mexican land distances were expressed in terms of the "vara."¹³⁸

The Chain. The United States adopted the chain unit of linear measurement. It was the 17th-century invention of Edmund Gunter, an English astronomer. Gunter's chain was 66 feet long and was divided into 100 links. In its early construction it was made of iron; later, heavy steel wire was used. This wire was in short pieces that were bent at the ends so that they formed rings. Three extra rings were fitted in between the pieces, so that each assembly made up one whole link, or 7.92 inches (66/100 foot). Handles, which were adjustable and had swivels, were located at the extreme ends, giving flexibility to the whole chain.

Obviously, there were a lot of surfaces to wear, about six times as many as the number of links. There were also many places for dirt, brush, twigs, and muck to get into, causing delays while the chain was cleaned. The chain required almost daily testing to make certain its length was correct. In spite of this, it was not replaced in general practice by the steel ribbon tape until about 1900.

In the Colonies of the English-speaking people in America, the land boundaries were measured by the chain unit, the most convenient unit for the computation of areas in acres. One acre is equal to 10 square chains. The 20.00- and 40.00-chain public land fractions for quarter and half mile distances make the subdivision of sections into

aliquot parts (called quarter-quarter and quarter sections) fairly simple. In units of area, these are, respectively, 40 and 160 acres. Ten chains along the section boundary gives the side of a quarter-quarter-quarter unit, or a 10-acre subdivision.

The Arpent. The French arpent was not used as a direct linear measure, but tracts of land were described in length and breadth in terms of arpents, the unit meaning the length of the side of 1 square arpent. In Louisiana, Mississippi, Alabama, and the northwestern part of Florida, 1 arpent was very nearly 0.84625 acres. The side of a square arpent equalled 2,909 chains.¹³⁸

The Vara. The vara was a unit of linear measure in both the Spanish and Mexican land grants. In the Public Domain of the southwestern United States, it equalled 4.1658 links. One hundred varas were 4.1658 chains, or 274.943 feet.¹⁴¹

As if this were not complex enough, the values accorded the arpent and the vara differed in different areas. In Arkansas and Missouri an arpent was 0.8507 acres, and the side of a square arpent was 2.91667 chains, or 192.500 feet. In Florida, 100 varas equalled 4.2136 chains, or 278.100 feet.¹³⁸

Doubtful Claims

Adding to the problem was the fact that, from the beginning of American control, there was ample reason for the court to have doubts about the authenticity of many of the grants. In Louisiana Territory, for example, Silas Bent, a government surveyor, reported that the records of his office had:

undergone a revolution, there has been Leaves cut out of the Books and others pasted in with Large Plats of Surveys on them. . . . the dates



The solar compass pictured above is the type of instrument used in the original surveys of the Willamette Meridian and Base Line. The picture was taken in Willamette Stone State Park.

have been evidently altered in a large proportion of the certificates. Plats have been altered from smaller to Larger, Names erased and other incerted and striking difference in colour of the ink etc. . . .

Although the writing was imperfect, his message was clear.¹⁵

In 1812, the State of Louisiana, formerly the Territory of Orleans, was admitted to the Union. At that time, the Territory of Louisiana was made the Territory of Missouri. When the Board of Land Commissioners for Missouri Territory made its report that year, it was found that all of the really large claims had been rejected. The aristocrats of the vast fur trading empire, such as the Chouteau family, then exerted their (considerable) influence to have the requirements for confirmation of their claims relaxed. Eventually, large grants were confirmed to members of the wealthy fur trading families, but they were only a small part of the land they had once claimed. All of this made more work for the surveyors, because, as grants once confirmed and surveyed were enlarged, they had to be surveyed again. In some cases, due to litigation and legislation, a third survey was required.

Private Claims—Before and After 1846

In the territory acquired prior to 1846, there were 18,643 private claims confirmed in 12 states. The total area was 10,253,671 acres.¹⁶

When the treaty with Great Britain ending joint occupancy of the Oregon country was signed,¹⁴³ and land from Mexico was acquired under the Treaty of Guadalupe-Hidalgo, the private claim problem once again presented problems.

Article 8 of the treaty with Mexico¹⁴⁴ said:

Mexicans now established in territories previously belonging to Mexico, and which remain for the future within the limits of the United States, as defined by the present treaty, shall be free to continue where they now reside, or to remove at any time to the Mexican republic, retaining the property which they possess in the said territories, or disposing thereof, and removing the proceeds wherever they please, without their being subjected, on this account, to any contribution, tax, or charge whatever.

Those who shall prefer to remain in the said territories, may either retain the title and rights of Mexican citizens, or acquire those of citizens of the United States. But they shall be under the obligation to make their election within one year from the date of the exchange of ratifications of

this treaty; and those who shall remain in the said territories after the expiration of that year, without having declared their intention to retain the character of Mexicans, shall be considered to have elected to become citizens of the United States.

In the said territories, property of every kind, now belonging to Mexicans not established there, shall be inviolably respected. The present owners, the heirs of these, and all Mexicans who may hereafter acquire said property by contract, shall enjoy with respect to its guaranties equally ample as if the same belonged to citizens of the United States.

When the American government took over control in California, about 813 private land claims had to be decided. Some grants were small garden plots near the missions, but the majority of them were from 1 to 11 square leagues (a square league was 4,426 acres). Most of the grants had been intended for grazing livestock and were not under cultivation. None were fenced, and most of them lacked identifiable boundaries. New Mexico, Arizona, and parts of Colorado also had tangled claims remaining from the period when Mexico ruled the area.

The United States government had the responsibility of translating the Spanish-Mexican puzzle of incomplete, conditional, unlocated, and unsurveyed land grants into a vastly different land system: one that recognized only fee simple titles or the type of conditional rights that had obligations to be fulfilled before title could be issued.¹⁵

New Mexico

In July 1890, the surveyor general of New Mexico explained a part of the reason behind the problems of private claims in that territory. The problem had its beginnings at about the time of the discovery of New Mexico, when Emperor Charles V of Germany (who was also the King of Spain) decreed:

If in that which is already discovered in the Indies there should be any places and districts so good that it may be proper to found settlements, and any person should make application to settle and reside in them, in order that with a greater will and profit they may do so, the viceroys and presidents may give them in our name lands, house lots, and water in conformity with the disposition of the land.



Aluminum Young and Son solar compass no. 8510. Records show it was in Colorado in 1911 and 1912. It came to the Olympia, Washington, GLO in 1913 and was used by Andrew Nelson that year. Herbert Raymond used it in 1914, and George R. Campbell used it from 1915 through 1918. The instrument is still in good adjustment and is still in use.

Further, the surveyor general reported,

This plan was pursued until the annexation of the territory by the United States. Under the Republic of Mexico the colonization laws and regulations became a . . . complete system . . . adapted to the . . . people . . . and to the . . . country to be occupied.

After explaining the differences between that system and the rectangular survey system used by the United States, the surveyor general commented that the remedy for the problems would be surveys, because "certain title to the land is the

foundation of all values. Enterprise in this Territory is greatly retarded because that foundation is so often found lacking."¹³⁵

Surveying these claims was also made difficult by the necessity of reconciling them with the American system of townships and ranges. Finally, the rectangular surveys were fitted around the older grants, no matter what their origin, shape, or size, or in what direction they lay. Many odd corners were produced by the closing of the rectangular surveys against the lines of these claims.

with the Principal Meridian
 (The point of intersection is on
 an isolated Hill on the west
 bank of Rio Grande about
 120 Chains NW of the Mexican
 town of La Joyita.) by John
 W. Garretson Deputy Surveyor
 under his Contract of 9th of
 March 1855
 I run the Principal Meridian
 South 60 miles. in April last
 I suspended operations on account
 of there being no water at that
 time on the Jornada Del Muerto
 Thence after running the
 Principal Meridian 48 miles
 north I received the report
 of the Commissioners of

the General Land Office in
 which the Standard Chain is
 described the Standard measure
 being the space between the rivets
 within the handles. The re-
 markably foolish penchant for
 novelty has cost me the running
 108 miles twice

The initial point is fully de-
 scribed in notes of Principal
 Meridian North of Base line

Chain compared and adjusted
 to the Standard measure

A small portion of deputy surveyor John W. Garretson's field notes of his 1855 survey of the New Mexico Principal Meridian.
 (Courtesy of Duane Olsen.)

OREGON DONATION LAW

The settlers in Oregon had passed an act that created a provisional government 3 years before the signing of the treaty that set the northern boundary at the 49th parallel. Under that law, any man was permitted to hold 640 acres wherever he wanted to establish a claim. The 1848 Organic Act creating Oregon Territory, which voided "All laws heretofore passed in the said Territory of Oregon making grants of land or otherwise affecting or encumbering the title to lands . . ." was, therefore, most upsetting to Oregonians.

Their distress must have reached Congress, because in September 1850, another Donation Land Law was passed. It was "An Act to Create the office of Surveyor-General of the public lands in Oregon, and to provide for the survey, and to make donations to settlers of the said public lands." This law granted 320 acres to every male settler, including American half-breeds, over the age of 18 who was a citizen or who had declared his intention

of becoming one before December 1, 1851, and who had lived in Oregon Territory and cultivated the land for 4 consecutive years prior to December 1, 1850. Further, if he married by December 1, 1851, his wife was entitled to a grant of a like amount of land to hold in her own right!—(At that time, it was a very uncommon privilege for a wife to be allowed to have real property in her own name.) White male citizens or intended citizens who emigrated to Oregon Territory between December 1, 1850, and December 1, 1853, and who had met the other obligations required by the act, were to have 160 acres.¹⁵

The Donation Land Law did not clarify titles immediately. It applied to unsurveyed lands not offered for public sale. The purpose of the law was to protect the bona-fide settlers until they had filed claims and received patents. After this was accomplished, the remaining lands, once they had been surveyed, came under the regular laws dealing with the sale of the public lands.²⁰

to the man Montana, about seventy
miles north of the house. Numerous
excellent trails also lead from the
house in various directions. A man
named McIntire keeps a hotel
on the reservation near the Hot
Springs. He sells bad whiskey, en-
courages gambling and charges ex-
orbitant prices. He has no permission
nor authority to live on the reservation
and should be put off, although
it would require physical force to
do it. The wagon roads are good
and were much used by tourists
last summer. I describe these hab-
itations because they are within 1 1/2
miles of the boundary. There are
about a dozen cabins built and
occupied, along the Yellowstone
River, between the boundary line

The field notes of the 1879 survey of the Wyoming-Montana boundary include this early case of trespass on the public lands.

Under the law, if the land was "deemed unfit for cultivation," only township lines were to be run. In other cases, only "necessary" lines were to be surveyed. A settler's request for a survey, in the case of individual land claims, made those surveys "necessary," as that was the only way to acquire clear title, or patent, to the land.

The Willamette Meridian and Base Line were established, and the survey of townships and ranges in Oregon's most heavily populated areas was begun in 1851. Even so, because the law had provided no required time for the donation-land claimants to complete their titles, often they were in no hurry to do so. In 1857, the Secretary of the

Interior stated in his report that "not having been empowered to hasten the surveys of private land claims . . . surveying in many townships goes on tardily, because settlers still withhold their requests for surveys." Because of this, much of the settled land was held under incomplete rights. As always, surveys were necessary before the sale of public lands, so no public lands were offered for sale in Oregon until 1862.²⁰

In other areas, particularly in the South-west U.S., private land claims delayed the extension of surveys into surrounding land and thereby kept those lands from being entered and settled. Often, when the claims were not valid and were not confirmed, the most desirable lands were affected. The fact that they were held back from survey and settlement sometimes retarded the development of a whole area.

The English-European heritage of the American Government made it extremely aware of property rights, and all claimants were given every opportunity to prove the validity of their claim to land. In all, 34 million acres of land in 19 States were confirmed to the holders of private claims.¹⁵

OREGON SURVEYS

John B. Preston, surveyor general for Oregon, chose a point in the hills just west of Portland as the initial point for the Oregon public land surveys. William Ives, who held Oregon Public Land Survey Contract Number 2, marked the point with a cedar stake on a day in early June 1851. This initial point, the intersection of the Willamette Meridian and its base line, is now well inside Portland's city limits. The cedar stake has long since been replaced with a concrete monument, and a small area around it has been set aside as Willamette Stone State Park.

In choosing the initial point, Preston followed the instructions given to him by Justin Butterfield, commissioner of the General Land Office. He used great care in selecting the place from which original surveys were extended for over 100 million northwest acres. Farms, fields, and forests from the California boundary to the Canadian border are described as east or west of the Willamette Meridian, and north or south of its base line.

In a letter Preston wrote to the commissioner of the General Land Office on June 14, 1851, he explained why he designated what now appears to be an obscure spot in Portland's west hills as the point of beginning for the surveys of the public lands of Oregon Territory:

Surveyor General's Office
Oregon City, June 14, 1851.

Hon. J. Butterfield, Commissioner,
General Land Office.

Sir: I have had the honor to transmit herewith a contract made with James E. Freeman, Esq., for surveying the Willamette meridian from the base line south to the Umpqua valley, and a copy of the special instructions given him. I also transmit a contract made with William Ives, Esq., for the survey of the Willamette meridian north of the base line to Puget's Sound and the base line from the Pacific Coast to the summit of the Cascade mountains, and a copy of the special instructions given him.

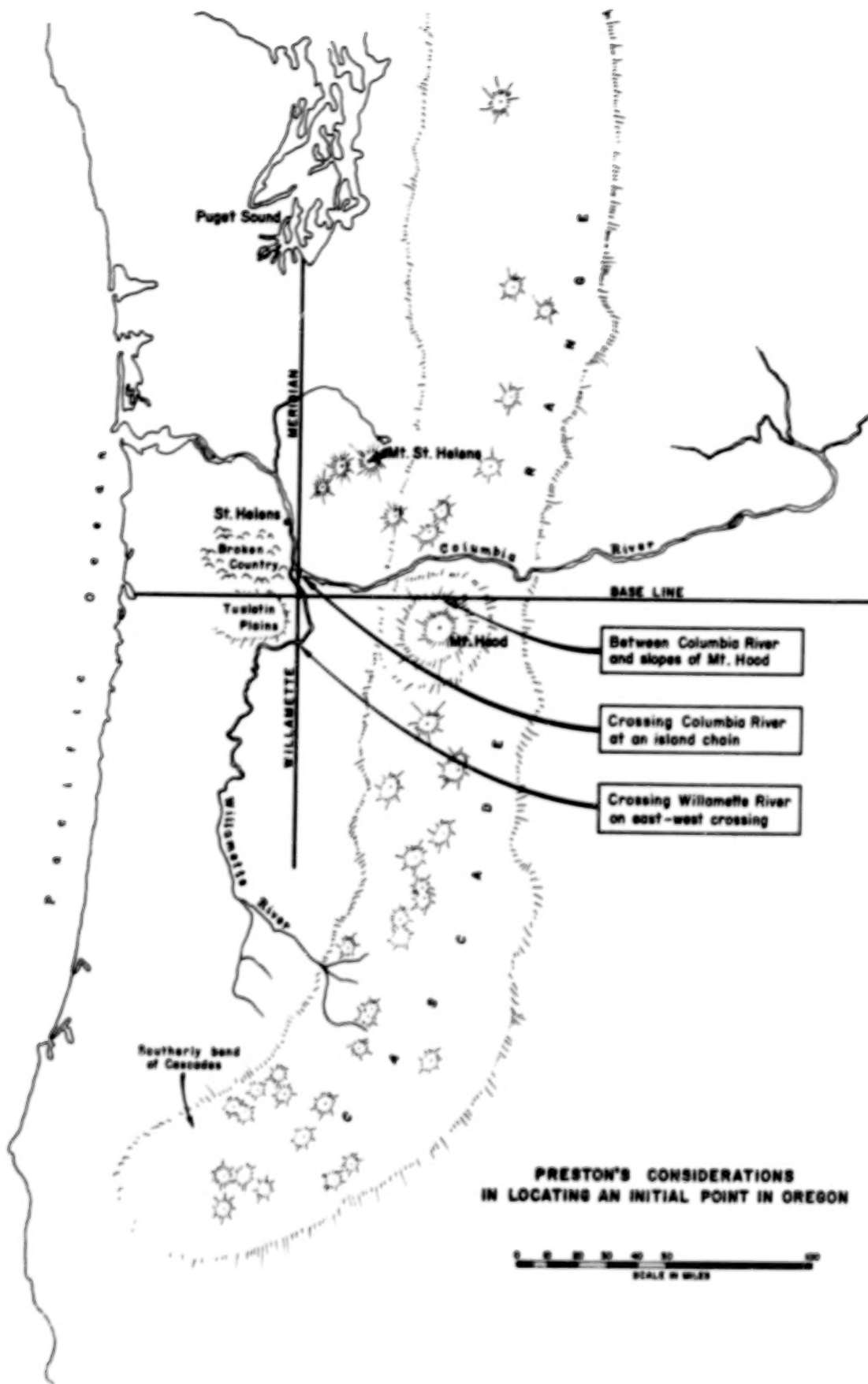
Previous to making these contracts I organized a party and visited the Columbia river and found it necessary to go as far east as the Cascade mountains in order to determine the point to start the base line so as to "avoid its southerly bend." After determining this I made a partial examination of the country near the mouth of the Willamette to find a proper point to cross with the meridian line. In the examination, I found that there was one small lake that would interfere but considered this much less of an obstacle than the broken country the line would have to pass over if thrown west of the lower mouth of the Willamette near St. Helens. Also believing that if the line was changed to the east there would be greater danger in running into the broken country at the foot of the Cascade mountains, I determined to locate the line on the point designated in the map accompanying your instructions. The point of intersection of the base and meridian line is $3\frac{1}{2}$ miles west of Portland. The base line will run through Portland on the Willamette and Hillsboro in Tualatin plains, $15\frac{1}{2}$ miles west of Portland. The meridian will run about five miles west of Oregon City. If the deputy surveyors find difficulty in getting men to assist them, the farmers are now offering \$5 and \$6 per day for men to assist in harvesting.

In order to advance the surveys, it will be necessary to give out some contracts for surveying township lines before the surveys of the base and meridian lines are completed. I have therefore desired the deputies on those lines to return their notes after they have surveyed 75 miles each. After these notes have been approved will get out contracts for surveying 25 township lines.

Very respectfully, your obedient servant,

JNO. B. PRESTON,
Surveyor General.

In his letter, Preston makes a rather casual mention of "visiting" various areas in his examination of the country to determine the site of the initial point. It would be well to remember, however, that, except for the emigrant trails and a few settled areas in the valleys, there were no roads



in Oregon Territory in 1851. At that time, rivers were the main highways of the Oregon country.

The men who accompanied Preston to Oregon Territory were all men whose work had recommended them. James E. Freeman had been a deputy surveyor in Wisconsin and Iowa.³⁵ He held public land survey contracts in Keokuk and Van Buren Counties in Iowa in the early 1840's.¹⁴

Freeman's Survey Party

James E. Freeman's party surveyed the Willamette Meridian from the initial point south "to the Canyon Mountains."²¹ According to surveyors who have retraced his lines, James Freeman was one of the best of the early surveyors. His work is considered excellent even by modern standards, as is the work done by William Ives, who initiated the survey of the Willamette Base Line in 1851.¹⁶⁰

When James E. Freeman started south on the initial survey of the Willamette Meridian, a young man named Zenas Ferry Moody was a member of his survey party. Moody, born in Granby, Massachusetts, was 18 years old when he traveled to Oregon by way of Panama. He arrived in Oregon City in April 1851. Just after his 19th birthday, Moody went to work as a chainman on one of the first United States surveys in Oregon Territory.²¹

On June 10, 1851, another adventurous young man arrived in Oregon City. His name was Kimball Webster. Webster had had less than unqualified success in seeking his fortune in the 1849 California gold rush, so in 1851 he started north.³⁵ When he arrived in Oregon City, Webster was disappointed to learn that the survey parties were already at work and had left the area. Later that year, Kimball Webster went south to join the Freeman party.

Zenas Moody was still one of the chainmen, and Kimball Webster became the axeman. He was doing a good job as axeman when Freeman discovered that Webster was well versed in trigonometry. It was Webster's good fortune that he had joined James Freeman's party, for Freeman was so dedicated to his job that he encouraged the men on his surveys to learn and assist him, and thus advance their own careers.

When Webster first joined the Freeman party, George Hyde was assisting Freeman in making calculations. After Hyde's departure, Freeman asked Webster to assist in making calculations. As soon as Freeman knew he could count on Webster's work, the job of making calculations became Kimball Webster's job.³⁵

If one reads the field notes of Freeman's Oregon public land surveys, a record of the progress of the

men of the survey party becomes clear. The field notes tell of both Zenas Moody's and Kimball Webster's education in the survey of the public lands. They were axeman, flagmen, markers, assistants, and instrument men. Over a period of time, they held all the jobs that would help them understand cadastral surveying. They were ambitious young men, but the opportunities to use what they had learned were opened to them by Freeman. It is to his credit that both Moody and Webster became competent surveyors and soon held survey contracts in their own names.

In March 1852, Kimball Webster was employed on a contract held by Robert Elder. Elder was the chief clerk in Surveyor General Preston's office when Webster first met him, shortly after his arrival in Oregon City. By the time Kimball Webster received his first appointment as a United States deputy surveyor on April 25, 1852, he had his own solar compass. It cost him \$350.³⁵ In June 1852, a survey contract was issued to Elder and Webster. Under this contract the two men operated a joint party. Kimball Webster received something over \$100 per month for his work. Webster's first contract in his own name was issued in December 1852.

Zenas Moody stayed with the Freeman survey party until 1853, and he became a deputy surveyor in Oregon in 1855. In 1856, he was appointed inspector of the United States surveys in California. After completing his job in California, Moody went to Illinois as the surveyor of Morgan County. In 1862, he returned to Oregon.²¹

In 1880, Zenas F. Moody became an Oregon state representative, and in 1882 became the seventh governor of the State of Oregon. His term was the longest single term of any Oregon governor. Moody was a popular governor, and his term of office was a smooth one. He died in Salem in 1917.⁷⁹

SURVEYS TO 1865

Information compiled by the General Land Office in 1865 indicated that, up to that time, no cadastral surveys had been executed in Arizona, Idaho, Montana, North Dakota, Oklahoma, or Wyoming. The surveys that had been done in Colorado were in the vicinity of Denver and Colorado Springs, as a result of the discovery of gold in that area.¹¹¹ Surveys in Nevada had been started,¹ and a few surveys had been executed in the Salt Lake City area of Utah because of the Mormon settlement. The settlers who lived along the Rio Grande prior to the annexation of Texas had required surveys, and that was the only area in New Mexico that had been surveyed.¹¹¹

THE STRANGE CASE OF THE SAN BERNARDINO INITIAL POINTS

Due to an extraordinary series of events that occurred over a period of years, there are three initial points for the San Bernardino Meridian and Base Line. These points and the surveys that established them were resurveyed by employees of the San Bernardino County Road Department as commissioned by the San Bernardino County Museum in 1966.

The story of the three initial points began in November 1852 when Henry Washington, a highly respected deputy surveyor, established the initial point for the San Bernardino Meridian and Base Line in southern California. The problems he encountered, including the lack of sufficient funds and the height and ruggedness of San Bernardino Mountain, are amply described in a report he sent to Samuel D. King, the surveyor general of California, the following month.¹²⁸

Washington did not survey the meridian and base line from the point he had established. His field notes do not indicate what method he used in surveying away from his initial point, but he did survey the west and south boundaries of Township 1 South, Range 2 West, and the west, south, and a portion of the east boundaries of Township 2 South, Range 1 West.

In 1876, Deputy Surveyor Albert Ruxton surveyed in the same area. He established monuments on the San Bernardino during a partial survey of Township 1 North, Range 1 East. Although Ruxton did not survey to the initial point, one of his monuments was established only 2 miles from it.

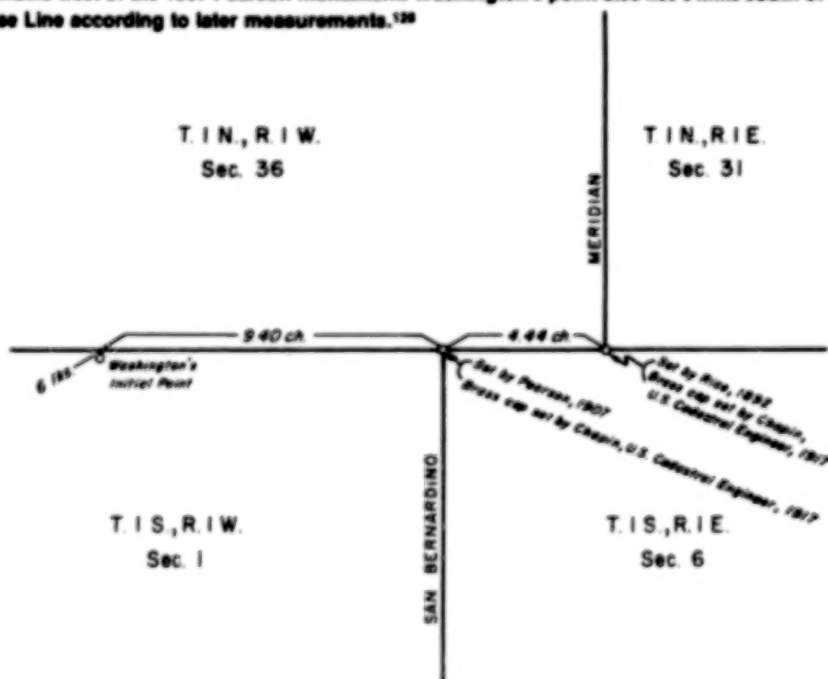
Deputy Surveyor John C. Rice completed the survey of the San Bernardino Meridian from the north, probably along Ruxton's line. He intersected the base line at a point he showed as being 13.45 chains east of Washington's initial point. Rice established a second initial point at that location. (The distance of this point from the first initial point was measured by the resurvey expedition as 14.04 chains.)

In 1907 George W. Pearson, deputy surveyor, set a third initial point when he completed the survey of the San Bernardino Meridian from the south. Pearson reached the base line at a point he said was 4.20 chains west of Rice's monument.

In 1917, Frank W. Chapin, a cadastral engineer, surveyed a part of Township 1 South, Range 1 West. Since surveys in the area were tied to them, Chapin accepted both Rice's and Pearson's points. He reset them with brass-capped regulation iron posts. These points have been measured as being 4.44 chains apart.

In 1927, Dupree Reed Averill, a United States surveyor, set a brass-capped regulation iron post beside the original 1907 marker set by Pearson. He also set the corner between Range 1 East and Range 2 East next to Pearson's marker of the same point.

The San Bernardino Meridian is offset 4.44 chains at the base line. Henry Washington's initial point would have put the meridian 9.40 chains west of the 1907 Pearson monument. Washington's point also lies 6 links south of the present San Bernardino Base Line according to later measurements.¹²⁹



Initial Points of the San Bernardino Meridian and Base Line as determined by the Washington Initial Point Resurvey Expedition.



about 1890

1 PERRIS	4 DOUGLASS	7 LINLEY	10 HARRIS	13 GENTON	16 JONES	19 YAGER
2 HARRIS	5 ROBERTSON	8 COL. STOKER	11 MRS. SMITH	14 CLOSTER	17 WALLER	20 M. RAE
3 STOCKTON	6 McNEILL	9 SMITH	12 COL. DELUCY	15 MRS. MAYNARD	18 HOLLAND	21 McKINZIE

U.S. SURVEYOR GENERAL'S OFFICE CLERKS

Montana, U.S. Surveyor-General's office clerks, about 1890.

Much of California had been surveyed because of the gold found at Sutter's mill, and also because of the settlement of California's agricultural land by people from the east. They had not found gold, but they did recognize the value of the land. There had also been a demand for surveys by the people who were living in California before the signing of the Guadalupe-Hidalgo Treaty of 1848.

Only a small portion of the southeastern part of South Dakota had been surveyed by 1865. The western parts of both Kansas and Nebraska were still completely unsurveyed at the end of the Civil War, even though settlements along the rivers and

in the timbered areas of Western Oregon and Washington had created the need for surveys there.¹¹¹

U.S.-CANADIAN BOUNDARY SURVEY

During the early years of the 1870's, surveys that had been delayed by the Civil War were being executed in many areas all across the United States. While the regular work of the cadastral surveyors continued, British and American surveyors were also at work marking the United States-Canada boundary. The line along the 49th parallel westward from the Red River occupied the

boundary commission during the 1873-74 survey season. It is probable that the first people who benefited from the fact that the international boundary line had been surveyed and marked in that area were Sitting Bull and his warriors. They fled across it after the Battle of the Little Big Horn, in 1877, to escape the pursuing American Army.²⁴

BLACK HILLS GOLD RUSH

At about this same time, geologists accompanied General Custer's expedition into the Black Hills in South Dakota. News leaked out of their reports that those hills were full of gold. The United States started negotiations to purchase the land meanwhile attempting to keep out gold seekers and settlers. Prospectors managed to evade the army's efforts to keep them away from the Sioux lands and, in 1875, Deadwood Gulch was the scene of an incredibly rich gold strike. By the beginning of 1876, there was another gold rush.²⁴

MORE OREGON SURVEYS

William H. Odell, who became surveyor general of Oregon in 1871, was born on December 25, 1830. When he was 21 years old he crossed the Great Plains with his father and spent 3 years helping his family become established on a donation land claim near Dayton, Oregon. Odell then entered the Oregon Institute (Willamette University) where he studied mathematics and surveying and became a chainman on a government survey party in 1854.¹⁶ He was a deputy surveyor in Oregon from 1864 until 1871, when he became the surveyor general.

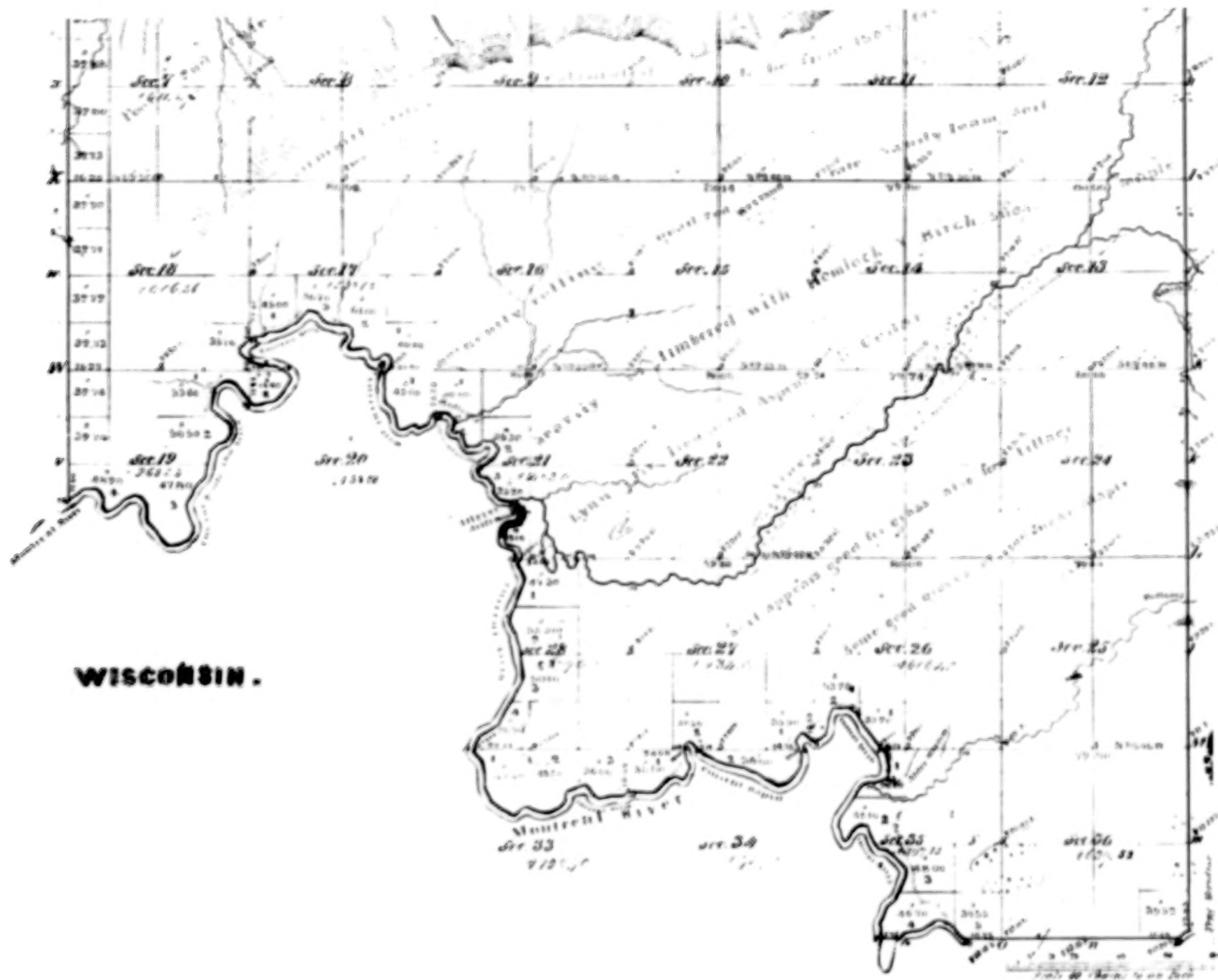
In his 1872 report to the Commissioner of the General Land Office, Odell stated that no one but the men who had surveyed west of the Cascade Mountains could know what the work entailed. He noted that "the interminable undergrowth and immense fallen trees make it exceedingly difficult to progress." In spite of this, he also recommended the swift extension of the surveys, due to the value of the timber and agricultural lands in the area. People were beginning to settle the land and had already gone ahead of the surveys in some areas.¹⁴⁰

By the latter years of the 1870's, the surveys in Oregon had long since finished with the Willamette Valley. By that time, the valleys in western Oregon were considered an "old" part of the United States. As early as 1871, a newspaper editorial stated that many newcomers to western Oregon expecting to find a new country were disappointed to find that it was as old as Kansas or Minnesota.²⁵

As the surveys were extended over more of Oregon, other deputy surveyors were hired. Among them were the Fitzhugh brothers, John and George, who worked in Curry County.

In 1879, John Fitzhugh, wrote a wry comment about the solar compass:

The solar compass is a fine instrument in the hands of an astronomer and mathematician. When in perfect order its results are quick and reliable, but under the control of an "ignoramus" it is the wildest "machine" that ever was used to trace a line.



A portion of a plat approved in 1849. The survey was done by William A. and Austin Burt and William Ives.



BRV 70-204

A mosaic of aerial photographs from 1950 of same area as shown on facing page.

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IN THE VANGUARD

Early surveyors, like other pioneers, accepted hardship and danger as part of their job. Field notes sometimes give small glimpses of the everyday life of the surveyors, or scanty, unembellished accounts of high adventure. Records of surveyors' experiences are usually short and disconnected. They tell of such diverse tribulations as camp life, rough country, storms, prairie fires, swamps, or hostile Indians.

WISCONSIN—1847

Deputy Surveyor Harry A. Wiltse once wrote a first-hand description of life on an 1847 Wisconsin survey. The survey lines ran through many miles of insect-infested swamp. In order to do their work, the surveyors had to carry all their food and equipment on their backs as they waded through high water and climbed over fallen trees. For four long weeks they endured attacks by clouds of mosquitoes. Their clothing was wet both day and night. Finally, they ran out of food and had to make a forced march in search of provisions. Wearing clothes that were nearly rotted away, they struggled for 3 days to reach a place where they could find food. During that 3 days there was nothing at all to eat. Little wonder Wiltse closed his written account of this survey by stating that he "would not again, after a lifetime of experience in the field, and a great fondness for camp life, enter upon the same, or a similar survey, at any price whatever."³⁰

SURVEYS PROGRESS

By the middle 1850's, the active period of public land surveys had ended in Ohio, Alabama, Arkansas, Illinois, Indiana, and Missouri. Iowa public land surveys were three-quarters finished, as were those in Michigan and Mississippi. The surveys in Florida, Louisiana, and Wisconsin were about half finished, and those in Minnesota, California, Kansas, Nebraska, New Mexico, Oregon, Washington, and Utah had been started.³⁰

The survey of the Nebraska-Kansas boundary, which is the base line of the Sixth Principal Meridian, was started in 1854. The line was run and marked, mainly with small wooden posts, for 108 miles westward from the initial point (52.55 chains west of the right bank of the Missouri River, on the 40th parallel). The cast-iron monument for the

initial point was set in 1855. It is marked: "NEBRASKA" on the north, "1854" on the east, "40° N LAT" on the west, and "KANSAS" on the south. When the line was resurveyed and remonumented during 1855-56, the former markers were destroyed. The line was extended from the 108th mile westward to the Rocky Mountains in 1858-59, as a base line of the surveys of the public lands.³⁴

Kansas Problems

Field note records of some original surveys executed in Kansas yield interesting insights into survey conditions. Consider this example of a good explanation for a delay in completing a survey contract:¹¹¹

... we would state that on or about the 1st of August, 1854, we repaired to the field of operations preparatory to executing the contract. On arriving in the field we found our work was immediately in the vicinity of headquarters of the hostile Indians and after skirmishing with us 2 days, they fired the prairies, completely demolishing everything for our cattle to subsist on for many miles, in fact the whole country lying between the Solomon and Republic Rivers, and we were forced to abandon our work.

Here is another:¹¹¹

At this place a party of Indians fired on me and my men. Their design was to kill me; they had previously threatened to shoot me and my men if I did not quit surveying there. A shell struck a tree against which I was leaning at that time, while my compass needle was setting [settling] not 6 inches from me.

Nebraska Troubles

Deputy M. McManus, from Sangamon County, Illinois, had a contract to survey in Nebraska Territory in 1855. He wrote a letter that December to the Surveyor General John Calhoun. In the letter, McManus wrote that one of his mules had broken its neck. He went on to lament about the troubles he had experienced on the survey and noted that it was surely not the same matter as retracing old lines in Sangamon County.¹³

Michigan Hazards

In 1855 the surveyor general of Michigan filed a report dealing with the swamps and the weather:³⁰

... a considerable portion of the surface of the country is low and swampy. ... in consequence of frequent rains the country has been rendered unhealthy, and nearly every party has suffered by sickness, and in one instance, by death. The duties have been so laborious that men have in some cases become refractory and left the field, making it necessary for the deputies to abandon their work for a time to engage new assistants.

Oregon Annoyances

In 1855, in Oregon, Deputy Surveyor Harvey Gordon reported that he had run into unexpected problems.³¹ He had been "obliged to carry my camp equipment on men's shoulders ... over the coast mountains, which are inaccessible to horses." He continued, saying that, after that hike, the men "... were unable to continue the work. I accordingly suspended operations to form a new party, but before I could do so the entire laboring portion of the community was seized with the gold panic. ... Wages climbed from \$52 to \$100 per month, and still Gordon could not find good men, even at that inflated wage.

Additional Survey Hazards and Difficulties

In Nebraska and Kansas that same year, 1855, the trouble was Indians. The surveyor general reported:

The progress of the surveys under my charge has been suspended ... on account of the positive refusal of the Pawnee Indians to allow us to proceed. ... Some Indians (chiefs) ... ordered us to leave ... and backed their orders with repeated threat that every man who did not leave the survey before the sun should arrive at meridian should be shot. ... They then pulled up all the posts set on the north side of the river, told us they would destroy all of the landmarks made in the vicinity, and that we must and should leave.

There was an Indian war in what is now the State of Washington in 1857. The surveyor general's report stated:³²

The paralysis caused by the Indian war, the scarcity of men and general impoverishment of the inhabitants, including the few land surveyors of the country, together with the exceeding topographical difficulty of the country,

has made it impossible to find deputies willing to contract for any work other than that reported.

In 1856, John S. Zieber, surveyor general of Oregon, called attention to the rugged scenery:³³

The public lands which remain to be surveyed in Oregon are probably rougher than any that have been sectionized in the Territories of the United States. Scarcely an unsurveyed township of land can be found without canyons, ravines, or precipitous hills; and most of the unsurveyed territory abounds in heavy timber (often standing and fallen), dense tangled undergrowth of bushes, briars, ferns, and grass, in many places covering a rocky surface almost impassable.

While all these events were occurring, homesteading was coming into its own and the surveyors were kept busy executing needed surveys and overcoming hardships. During the latter part of the 19th century, the fires that sometimes swept over the prairie land were often a hazard. In Nebraska in 1872, a surveyor named W. E. Harvey suffered a great loss from such a fire. One day in July, when his cook went to the river for water, the prairie grass caught fire and burned all their clothing, bedding, and most of their provisions. Surveyor Harvey counted himself lucky because he was able to save the field notes.³⁴

Water was also a problem. Moses K. Armstrong, on a survey of the south line of Dakota, had too much. He wrote that he was "quite sick with a cold from wading so much in mud and water." At other times, the problem was too little water. Occasionally surveying parties had to haul water many miles. Deputy surveyor W. A. Richards once wrote: "Old Jim (a mule) tipped over on a side hill but did nothing worse than smash a water pail—which is bad enough in this country."³⁵

One terse entry in the field notes of an early-day deputy surveyor in the southwest states, "The point for the corner fell on top of a bluff occupied by hostile Indians. I set a witness corner."³⁶

A Surveyor's Journal

W. A. Richards kept a journal on a survey of the southern boundary of Wyoming. The contract for the survey was held by Alonzo V. Richards; W. A. Richards was a member of the survey party.³⁷ The September 16, 1873, entry describes an evening in a survey camp:³⁸

The camp was in a wooded area and consisted of a temporary shelter of boughs. There was a blazing, pine-log fire burning and the mules had been tied at one side of the bivouac for the night.

The surveyors packs were stacked at the other side of the camp and a nearby tree was "decorated" with a dressed-out deer.

He said that the men were sitting by the campfire playing their nightly game of euchre [a card game]. In his journal, Richards also mentioned having copies of "Harpers Weekly" with him, and he noted that he had also read "Martin Chuzzlewit," "Tom's Vindication," and "Nicholas Nickleby" during that summer survey season.¹³

Frontiersmen by Choice

While many early surveyors became expert woodsmen, plainsmen, and mountaineers, they were not really like most of the trappers and cowboys who lived a similar frontier life. The surveyors were, for the most part, not born to primitive conditions. They were often among the best educated men of their time.

Some of them were accustomed to luxury, and many of them had known the pleasures of a well-ordered, comfortable existence. The two-sided world to which they adapted was of their own choosing. They chose an exhausting and exciting life of adventure in the marking of America's frontier lands, even though a number of them were as familiar with good food and service in elegant surroundings as they were with tin plates of salt pork and beans in a survey camp.

Buck's Tragedy

With all their problems, most surveyors fared better than did Deputy Surveyor Nelson Buck. Buck had been a surveyor for more than 30 years when he made application, in 1867, to survey the area from Red Willow and Frontier Counties in Nebraska westward to the Colorado line.¹³ His application was refused because of the hostility of the Indians in the area.⁹⁶ Buck reapplied in early 1868 and explained that he would have a large, well-armed survey party. He felt sure they would be able to protect themselves. He also mentioned his long and successful career as a frontier surveyor. The officials relented, and on June 29, 1869, an item in the Plattsmouth, Nebraska, newspaper stated that Buck had received the surveying contract. This became locally known when Buck arrived in Plattsmouth, and hired two teamsters, bought provisions, arranged for wagons and teams, and started out for Fort Kearney.

Buck wrote a letter on July 21, 1869, and mailed it from Fort Kearney. In it he mentioned that he had not obtained the arms and ammunition at the fort

that he had wished to take with his party. He also wrote that reports of more trouble with the Indians had caused some of his men to "take other employment."

That letter was the last communication anyone ever received from Nelson Buck or the men who were with him when he started his survey. In October it was found that no corners had been set. No evidence of any survey work could be located, nor could the survey party. Later, a place where the survey party camped was found, silent witness to what must have taken place. The camping equipment was there, as were tripods, part of a wagon, canned goods, and even an engraved silver spoon. The campsite was less than 40 chains north of the Kansas Line, about 4 miles southwest of Danbury.⁹⁶

Allason's Tribulations

In November 1869 another Nebraska deputy surveyor, W. J. Allason, reported that he had encountered several difficulties and found himself face to face with ruin. He felt that the surveyor general was not sympathetic, and told him so in a letter:¹³

. . . [I cannot] see what satisfaction you [the surveyor general] can reap by taking advantage of the misfortunes of one who has nearly all he is worth in this one contract. I had to correct a mistake in my line and was hindered on account of high water and to cap the climax I was burnt out. And now you are so I learn trying to get the Commissioner to claim the forfeit of my bondsmen and annul my work altogether. God knows I never did you any harm by word or deed and if you cause my ruin by what may be your legal power may your future happiness and prosperity be in accordance with its justice.

ARIZONA INITIAL POINT

In 1863, a surveyor general was appointed for the newly created Territory of Arizona. He started for Arizona, but the Report of the Commissioner of the General Land Office for that year stated that "no report has been received from him since his departure." Apparently they never did hear from him, so finally, the job of selecting the initial point for the Arizona surveys fell to the surveyor general of New Mexico, John A. Clark.

On May 24, 1865, Clark made the following report:¹¹²

Immediately opposite the mouth of the Salado on the south side of the Gila, there is a conical

GENERAL DESCRIPTION OF T. 24 N., R. 108 W., SIXTH
PRINCIPAL MERIDIAN, WYOMING (1900)

On page 62 of the "Manual of Surveying Instructions, 1894," there appeared the following requirement:

"Besides the ordinary notes taken on line (and which will always be written down on the spot, leaving nothing to be supplied by memory), the deputy will subjoin, at the conclusion of his book, such further description or information touching any matter or thing connected with the township (or other) survey which he may be able to afford, and may deem useful or necessary to be known—with a *general description* of the township in the aggregate, as respects the face of the country, its soil and geological features, timber, minerals, waters, etc."

On May 3, 1900, Edward F. Stahle, U.S. deputy surveyor, penned a general description of a township (T. 24 N., R. 108 W., 6th P.M., located about 10 miles southwest of Ferson, Wyoming) he had just surveyed. In it he follows the above manual requirement to the letter—and a bit beyond:

"The land in this township may have, at one time, been covered with a luxuriant growth of grass, but at the present writing, that is the scarcest product of the soil.

"Both the noble red man and the magnificent bison doubtless had many an exciting chase over its billowy stretches, owing to the number of arrowheads used by the former, and the horns of the latter, scattered over it. But there are none here now.

"It was doubtless covered with water at one time, as is demonstrated by the vast number of fossils found upon it, but I regret to say, that there is no water here now. Our parched lips and swollen tongues emphasized this condition too often for comfort.

"There were a large number of trees growing on it, during the grassy, watery days of yore as we found a number of petrified stumps, but there are no trees here now. Our frugal noonday repast could not be partaken of under the shade of a petrified stump and we were compelled to expose our handsome, bewhiskered, sun-browned visages to the scorching rays of the meridian sun.

"As we did not find any banana peelings, coconut bark, peanut shells or corn husks, it is fair to assume that the soil never was fruitful or productive. In fact, it is not now.

"Indications point strongly to the fact, that it was adapted to neither horticulture or floriculture. We found no signs of carnations, roses, or honeysuckles. We occasionally stumble over a protruding root but doubt that they ever belonged to the grape vine.

"This may have been a paradise for birds and bees; not that we found any vestiges of antiquated aviaries or apiaries or any other signs of bird or bee life, but they may have winged their flight across the township. However, there are none here now.

"A meadow lark did warble his lay on a twig of rabbit brush, and then disappeared. That is the lark; the rabbit brush remains as proof of my story. While animal and bird life seems to have become extinct here, we are not entirely void of live companionship. Horned toads, scorpions, centipedes and many other like charming bed fellows, are quite plentiful.

"Nature has, at the present time, been niggardly in distributing shade trees and shrubbery, but while there are no sweet peas, gladiolas or lemon verbena, the beautiful white and sweet sage and prairie cactus abound.

"If perchance we failed to notice the latter in perambulating about, and our foot came in contact with it, we have heard other names applied to it than beautiful. As one pursuing sedentary habits would avoid a tack on a chair, so we, whose habits are of a peripatetic nature are cautious of the sharp needled points of the cactus.

"Taking it all in all, however, for some unaccountable reason sheep manage to exist here in the winter time and that is all there is of it, excepting a few scattered agates and topaz."

Edward F. Stahle
U.S. Deputy Surveyor

hill about one hundred and fifty feet in height, upon the pinnacle of which Mr. Bartlett, in making the survey of the boundary line under the treaty with Mexico of Guadalupe Hidalgo, established a corner "to mark the mouth of Salt River." I visited this monument and found it compactly built of stone, circular, about eight feet diameter at the base, four feet at the top, and eight feet high, with a post four inches in diameter projecting from the center of the top about six feet, upon which is marked: "United States and

Mexican Boundary Survey, 1851.—This monument erected in 1851 to mark the junction of the Gila and Salt River.—A.H. Gray, U.S. Surveyor." The hill upon which the monument is erected is . . . a remarkable landmark: and being . . . opposite the mouth of the Salado or Salt River—the geographical position of which has been determined—and, with respect to the arable land of Arizona, being very central, I have selected it as the initial point for the Meridian of that Territory.

The "conical hill" is a short distance southwest of Phoenix. It is named Monument Butte. It was from the monument selected by Clark that the Arizona cadastral survey grid was extended. On January 19, 1867, William H. Pierce and a party of four men began the survey of the Gila and Salt River Base Line. They surveyed eastward, and in 4 days they had completed 36 miles along the route of present-day Baseline Road. In 1911, surveyor Guy P. Harrington made surveys from this initial point. He took photographs of the hill and the monument, and for many years afterward the monument remained intact.

In 1945, a cadastral engineer named Ty White made the tie from a nearby triangulation station to a point that he identified as the initial point. A photograph was taken then, too. Rocks from the mound described by Surveyor General Clark 80 years before were shown scattered about, instead of piled neatly as they were formerly for so long.¹¹²

On April 25, 1962, the 150th anniversary of the founding of the General Land Office, a historical monument marking the point of beginning for the cadastral survey of the public lands of Arizona was dedicated. It is not a grand heap of rocks, as was that first monument. Instead, it is a regulation brass-capped iron survey post, set in a short, slightly tapering concrete pillar. On one side of the small obelisk is a granite plaque that tells the nature of the marker and lists the important dates concerning its history.¹¹⁹

RAILROAD GRANTS

During the Civil War, before John A. Clark chose the initial point for the Arizona surveys, the need for a connecting link between the isolated Pacific coast and the eastern part of the Nation became evident. Out of this need came the grants, in the latter half of the 19th century, of extensive portions of the public lands to aid the construction of a transcontinental railroad and telegraph system. The grants were for the rights of way, plus alternate sections of land. Some of the land granted to the railroads was sold to settlers. Other people settled on the alternate sections of public land along the route of the railroads.

The Act of July 2, 1864, under which land was granted to the Northern Pacific Railroad, provided "That the President of the United States shall cause the lands to be surveyed for forty miles in width on both sides of the said road, after the general route shall be fixed, and as fast as may be required by the construction of said railroad. . . . The route for the railroad was selected by railroad surveyors, but

the railroad land grant surveys were public land surveys. They were executed by United States deputy surveyors.⁷⁵

O&C Lands

Certain odd-numbered sections of the Public Domain in western Oregon were granted to the Oregon and California Railroad Company in 1866. The terms of the grant were violated, so Congress, in 1916, ordered the remaining unsold part of the grant returned to public ownership. The checker-board pattern of the O&C revested lands, along with the reconveyed Coos Bay Wagon Road grant lands, include more than 2.5 million acres of some of the most valuable and productive timber lands in the United States.¹⁰⁶

Golden Spike

The Union Pacific and the Central Pacific Railroads were the first to receive land grants. When they met at Promontory Point, Utah, on May 10, 1869, a golden spike was driven. At the same time, an iron one was to be driven, and it was attached to the telegraph system in such a way that the contact of the hammer's blow, as the spike was driven to join the two sets of rails, sent a signal across the nation from the Atlantic to the Pacific.¹³

In the latter half of the 19th century, Congress passed several acts that authorized grants of public land for various purposes. The Homestead Act and the Act of July 1, 1862, which granted public lands for railroad rights of way, and the Morrill Act, which authorized public land grants to aid in the establishment of certain state colleges, were all passed in 1862. The Homestead Act was liberalized several times in the following years. This was in accordance with the idea that homesteaders would become permanent settlers.

In 1869, the first extensive geological and geographical surveys were authorized. These surveys were of potential mineral lands, particularly within the Rocky Mountain region. They were executed by United States deputy surveyors who held private contracts under the supervision of the General Land Office. Geographical and geological surveys continued in this way for 10 years. At that time the Geological Survey was established as a separate office of the Department of the Interior.²

Mining, Timber, and Railroad Interests

The Mining Law of 1872 opened the valuable mineral deposits in the lands belonging to the United States to further prospecting and development. One of the requirements for obtaining a

WESTERN TRAVEL—BEFORE THE RAILROADS

Something of western travel conditions in the early 1860's may be learned from an account written by Benjamin Randall who left Boston, to take care of business in Colorado, during the summer of 1862.¹⁰³

Randall was 20 years old, and enthusiastic about his adventure as he traveled by rail as far as Atchison, Kansas. There was no railroad across the prairie west of the Missouri River, so he was interested to learn that the Butterfield Overland Dispatch Route had just sent a stagecoach from Atchison to Denver. He was on the next one when it left on September 29th.¹⁰³

The Stagecoach

It was a Concord coach, the most popular type of stagecoach in the West. Its name came from its place of manufacture—Concord, New Hampshire. It was said to be the most comfortable vehicle of its era for travel over unpredictable roads. Its swaying, ship-at-sea motion was caused by the fact that the coach body was suspended on heavy leather straps attached to rocker springs.¹³

Inside the coach were two seats, one facing frontward, the other backward. A removable third seat was often placed between the other two. With three seats in place, it was considered a 3-passenger vehicle. The driver sat in front of the coach, feet forward against the footboard. On the floor in this section were carried tools, a water pail, a buffalo robe, and the strong box. The baggage section projected from the rear of the coach and was covered with heavy canvas or leather. Extra baggage and mail sacks were carried on top of the coach. They were held there by a railing around the roof.¹³ The Concord coach that carried young Randall had three seats, and was pulled by four good horses. There was a new road across the rolling prairie, so they reached Topeka at 10 o'clock that night.¹⁰³

They ate supper and started out again. That night Randall traveled through his first Indian country, the Potawatami Indian Reserve, so he did not sleep much. The travelers changed horses at St. Mary's Stage Station at 4 a.m.

The Last House on the Plains

They reached Salina, "the last house on the plains," at 3 o'clock the following morning. For the next 400 miles there was nothing but open country and the huts where the herders for the stage teams stayed. Randall described the first of these huts as being "two forked sticks five feet long stuck in the ground and a stick laid from one to the other so that when he (the herder) threw his blanket over the cross stick it made an 'A' tent."

Surveyors Noted

As the teams were being changed, the station herder told them there had been no return stage. The herder was sure the Indians had "inspected" it. At this point, Randall noted that a party of U.S. Government surveyors had killed some rattlesnakes nearby. The stagecoach continued on. Later they came across the missing stage passengers and driver, who had taken refuge with a wagon train. The stage had, indeed, been "inspected" by the Indians at Monument Rocks Stage Station.

In order to have help sent to the wagon train and its unexpected guests, Randall's stage started back toward Atchison. Along the way they saw "immense herds of buffalo." They reached Rushton Stage Station at 6 o'clock in the evening, and met a Government survey party. This time the surveyors had a cavalry escort. The stage driver and his passengers were hungry, so the surveyors treated them to a meal of buffalo steaks.

The people on the stage took a different route and had no more trouble on their way to Denver. One assumes that the survey party, still surrounded by hostile Indians out on the remote, rattlesnake-infested 1862 Kansas prairie, went right on with its surveying.¹⁰³

patent to a mining claim was a boundary survey. The survey was to be paid for by the claimant.

The Timber Culture Act of 1873 granted tracts of the public lands to settlers who planted trees on the plains. The Timber Cutting Act of 1878 permitted settlers in Colorado, Nevada, the Territories of Idaho, Montana, Dakota, Wyoming, Utah, and New Mexico to cut timber for agricultural, mining, or domestic purposes on lands that were not subject to entry except for mining.¹⁵

All of these acts, along with the Forest Management Act of 1897, with its Forest Lieu Section, and the Preemption and liberalized Homestead Acts, were passed to help settlers. Many of the people who backed some of these laws, such as Senator Henry Moore Teller of Colorado, did so in good faith. Unfortunately, by the time the laws were actually passed, they were so full of loopholes that they almost invited fraud.¹⁶ Fraudulent use, speculative abuse, and the exploitation of vast

natural resources on the public lands for private gain was the ultimate result.

The first National Forest Reserve, called the Yellowstone Park Timberland Reserve, was established under the Act of June 4, 1897. It was to be surveyed, protected, and managed by the General Land Office.¹ The GLO was really prepared to handle only one part of the job—the surveys. Binger Hermann, then commissioner of the GLO, apparently realized the limitations caused by this fact. And from the beginning, many persons including Hermann were disturbed by the forest lieu portion of the Forest Management Act. Under this provision, any owner or claimant to land within the reserves was allowed to give up that tract and select an equal area of vacant land in its place.

The lieu provision was intended to help settlers who feared that their land would not be permitted access roads if it was enclosed by forest reserves, or that churches and schools would be kept out and that their land would thus be made less valuable. Regardless of the good intent, however, it was soon apparent that the lieu provision was being taken advantage of by speculators who bought State or railroad land that had little value or from which the timber had already been cut. These lands were then exchanged for choice timberlands outside the reserves.¹⁵

The major beneficiaries of this Act were the Santa Fe, the Northern Pacific, and the Southern Pacific Railroads. Through the purchase of lieu scrip from the railroads, the timber companies also acquired valuable lands. The railroads frequently exchanged lands fit only for grazing for lieu scrip, which they then sold to the timber companies. The huge timber companies then exchanged the scrip for extremely valuable timber holdings.

In October 1898, Binger Hermann warned that the forest lieu land selections were being misused. He was afraid that the open exchange of grazing land or land that had already been logged for valuable timber land would lead to pressure from the people who were actually making money from this law, for the creation of more land reserves with more lieu land scrip. Six months after he had expressed this fear, Mount Rainier National Park was created, and the Northern Pacific Railroad was given the right to exchange its worthless rock and brush land on the side of the mountain for surveyed and unsurveyed lands outside the Mount Rainier National Park.¹⁵

Transfer of Forest Reserves

During the next few years, as the General Land Office made little headway in the administration of

the forest reserves, Gifford Pinchot mounted a large-scale campaign to transfer the forest reserves to the Department of Agriculture so that they would come under his direction. Meantime, Binger Hermann fell into difficulty with corrupt elements in Oregon who were using the very loopholes he had once warned against. Prior to his dismissal, Hermann destroyed incriminating evidence—an act for which he was later indicted. The ensuing scandal (which involved various officials including a U.S. Congressman and a Senator) fairly well discredited the General Land Office's administration of the forest reserves.

By the Act of February 1, 1905 (33 Stat., Part 1, p. 628), Congress, with the approval of W. A. Richards, Hermann's successor in 1903, transferred the forest reserves to the Department of Agriculture. The General Land Office retained responsibility for surveys and for the administration of the mining and land laws within the National Forests.¹

Wasson's Report

Commissioner Hermann was not the first person to inform Congress of the inequities and abuses inherent in the various public land laws. In his 1880 report to the commissioner of the General Land Office, John Wasson, the surveyor general of Arizona, seconded the conservation and resource management ideas of the Public Land Commission, which had been authorized by Congress in 1879. The Land Commission had collected information and made recommendations to be used in disposing of the public lands in the western part of the United States to actual settlers. Wasson's report stated:¹³⁶

It is mere bosh to orate about our vast unsettled and uncultivated domain which cannot be populated to any great extent under present legislation; and it is a cruel wrong to the poor to induce them to go upon . . . [nonirrigable land valuable only in large tracts for pasturage] to make homes. . . . [I recommend] all the irrigable agricultural . . . lands be . . . immediately surveyed into townships and offered for sale in large tracts . . . with the imperative condition of providing water . . . as the case may require. . . .

Apparently there were enough surveyors available to help prevent claim disputes and abuses of the mining laws in some States. Albert Johnson, the surveyor general of Colorado, commented in 1880 that the part of his report giving the names of the deputy surveyors was of interest

"chiefly . . . from the fact that there are so many of them." The vast majority of them were mineral surveyors, so he went on to say that, "claimants can make no just complaint of the scarcity of surveyors, as there are large numbers in every mining camp. . . . It seems as if surveyors especially had heeded the admonition of the . . . sage [Horace Greeley], whose advice was, 'Go West, young man.'"¹³⁶

Reservation of Public Lands

The reservation of public lands was a high-minded effort to preserve certain areas for the people of the United States. In the early years of the westward migration, the land of the United States seemed so vast as to be almost limitless. That is why the provision, under the Ordinance of May 20, 1785, which set aside land in each township for the support of public schools was so remarkable.

It also required great foresight, during the early 1800's, to reserve townships in Indiana that contained salt springs, as did the action by which four sections surrounding the Hot Springs in Arkansas Territory were "reserved for the future disposal of the United States" by section 3 of the Act of April 20, 1832. The survey of the public lands did not reach the area of the Hot Springs until early in 1838. At that time, the south half of both sections 28 and 29, all of both sections 32 and 33 in Township 2 South, Range 19 West, and the north half of both sections 4 and 5, in Township 3 South, Range 19 West, were reserved.¹³⁶

Gradually, other public lands that were of great natural beauty, or that were in some way unique, were set aside. In 1864, the "Gorge" and headwaters of the Merced River "known as the Yosemite Valley" and the "Mariposa Big Tree Grove" of giant sequoias were given to the State of California to be held for all time for "public use, resort, and recreation."¹⁵

In 1872, some 2 million acres on the Upper Yellowstone River, near the junction of the boundaries of Idaho, Montana, and Wyoming, were set aside and dedicated "as a public park or pleasuring ground for the benefit and enjoyment of the people." In 1890, legislation set aside lands in California that became Sequoia, General Grant (later part of Kings Canyon), and Yosemite National Parks. Prior to 1900, as an outgrowth of this legislation, Mount Rainier National Park in Washington was also created.

The State Park in Yosemite Valley was eventually ceded back to the United States. It became a part of Yosemite National Park in 1906.¹⁵ As years passed,

other tracts of public land were withdrawn and dedicated as National Parks, National Monuments, Wildlife Sanctuaries, and National Forest Reserves. The boundaries of these areas were run and marked by cadastral surveyors.

More of the speculation and fraud possible under certain laws was pointed out by the commissioner of the General Land Office in his 1890 report:¹³⁵

The Act of June 3, 1878, providing for the sale of [timber and stone] lands in California, Oregon, Nevada, and Washington should be repealed. I have found . . . that while it provides for entries of not more than 160 acres in all, for the sole use and benefit of the entryman . . . it has been made the vehicle of speculative and fraudulent appropriation from the beginning . . . and has caused the destruction of the forests where most needed [to protect the watersheds].

This act—the 1878 Timber and Stone Act—eventually was repealed, as was suggested in 1890. However, such things apparently take time; it was not repealed until 1955.¹

Fraudulent Surveys

In the 1800's, General Land Office examiners of surveys discovered evidence of both fraudulent entry upon the public lands and fraudulent surveys of those lands. A large-scale investigation followed. The annual reports of the GLO for the years of those investigations show that the frauds eventually involved persons in positions of trust. Unfortunately, this included a few deputy surveyors who were unable to resist the temptations offered to them.

Of those cases that involved fraudulent surveys, the California frauds were the worst. Of them, the Benson Syndicate cases stand out as the most infamous. Among them were cases of fictitious holders of surveying contracts, false witnesses, faked field notes, false oaths, and fraudulent payment of drafts on the United States Treasury. Those involved in the Benson Syndicate activities included employees in the office of the surveyor general as well as deputy surveyors, well-known bankers, and John A. Benson himself. The syndicate operated in California and other Western States primarily in the 1870's and 1880's. Several surveying contracts and a few hundred thousand dollars were ultimately involved—in all, a very small percentage of the number of surveys executed during those years. This regrettable era ended in 1898 when the last of the Benson fraud cases was closed.³⁰

Business as Usual

During the era of fraudulent surveys, the ordinary, honest surveys proceeded as usual. In 1880, the surveyor general of Utah reported that there had been a good bit of trouble in Utah Territory because of the loss or destruction of the public survey corners established in certain localities during the 1850's. He wrote that, according to his information, the principal reason behind the destruction of the markers was the fact that the Mormons, having been instructed by their church to do so, plowed up and destroyed all the corners and had their land run off into 5- and 10-acre lots.¹³⁶

Public land in the central part of Indian Territory (Oklahoma) was opened to homesteaders on April 22, 1889.¹ Thousands of settlers took part in a thundering stampede for choice land in the new

area. In the years that followed, other well-known "runs" occurred, as treaties were negotiated, and Indians took allotments for their reservations. Less well known is the fact that all these areas had been fully surveyed before they were opened for settlement.

With all the usual difficulties, including illness and injuries, early surveyors also had their share of red tape to untangle. On March 19, 1889, Deputy Surveyor Thomas S. Wilkes wrote to Douglas W. Taylor, then surveyor general of Oregon, about his field notes. Wilkes wrote Taylor that he possessed patience⁷⁶

. . . of vast extent, and I'll keep sticking on my autograph as long as it lasts and . . . hope to get the notes written up inside of the period of my natural life so that they suit the fastidiousness of the General Land Office and fill all their red tape requirements.

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THE DIRECT SYSTEM

F. V. HAYDEN

During the 1850's, the Sioux of the northern plains grew accustomed to seeing a slim, bearded young man with a bag over his shoulder and a small pick in his right hand. They thought him mad because all he did was hurry from place to place, gathering rocks. They gave him an Indian name that was said to mean "man-who-picks-up-stones-running," and left him alone. His real name was Ferdinand Vandiveer Hayden,⁴ and he was not mad; he was an unusual young man who had found a career in geology at a time when it was not really a respectable thing to do.

Hayden had become a teacher at the age of 16 and two years later entered Oberlin College in Ohio. When he graduated from Oberlin in 1850 he was considered an impractical, dreamy young man. Nevertheless, Hayden entered medical school, studying geology and paleontology while he earned his degree in medicine. Immediately after receiving his M.D., he accepted an opportunity to spend a season in the Nebraska Territory (now South Dakota), collecting Tertiary and Cretaceous fossils of the White River Badlands.⁴ This was the beginning of Hayden's remarkable career as a geologist and explorer-surveyor.

During the following 10 years, Hayden served his apprenticeship as a scientific explorer. He decided that he wanted to explore the headwaters of the Yellowstone River, for he had heard fantastic tales of it. And he also wanted to explore the central Rocky Mountain region. He had the germ of an idea for a Government-financed geological survey that might serve to introduce the great natural resources of the country to the people of the East.

In the comparatively peaceful period that followed the agony of the Civil War, the American people focused their interest on the West. By 1867, Andrew Johnson was President of the United States. The rails of the Union Pacific were being extended westward while those of the Central Pacific already reached east to the High Sierras. Cattle were being raised in Texas, and soon they would be driven north to feed upon the Great Plains where as yet only buffalo grazed. The time was right for experienced scientists to take advantage of the situation. A handful did, and one of them was F. V. Hayden.

Hayden's Surveys

Hayden's opportunity to have his own survey came about when Nebraska became a State on March 1, 1867. Money had been appropriated to defray the expenses of the Nebraska Territorial Legislature and some of it was unspent. Congress granted this unused sum "for the purpose of procuring a geological survey of Nebraska, said survey to be prosecuted under the direction of the Commissioner of the General Land Office" (14 Stat. 470).

Hayden was appointed the geologist in charge of the Geological Survey of Nebraska. The following year, he was authorized to conduct another survey. By 1869, the transcontinental railroad was completed and Hayden's appropriation had grown to \$10,000—double that of the first two years. The Geological Survey was removed from the administration of the commissioner of the General Land Office and put directly under the authority of the Secretary of the Interior. It was also given a new name—the United States Geological Survey of the Territories (15 Stat. 306).

Yellowstone-Teton Region

In the next few years, large, well-outfitted parties under Hayden's leadership explored and mapped the legendary Yellowstone area and the splendid Teton Mountains. The Indians called this region, which now includes Yellowstone National Park and Grand Teton National Park, "the top of the world." Mountain men knew this magnificent land existed, but fur-bearing animals were plentiful in more accessible areas, so they did not go there. Travelers on the Oregon Trail bypassed it because the few passes that exist are snowfilled for 9 months or so of each year. And the miners who had found gold in Montana, Colorado, and the Dakotas had no reason to go there. So, until 1871, when Hayden led the first Government expedition into the area, it was virtually an unknown land. Without a doubt, the Hayden survey helped make the American people aware of the grandeur of the area and fanned their interest in its preservation.

Central Rockies

The Ute Indians were removed from much of the central Rocky Mountain mining area by the San

Juan Cession of 1873. It was an area that was about to feel the pressure of westward expansion and, suddenly, the fact that no reliable maps of the region had ever been produced became a matter of importance. In his "Annual Report of the United States Geological and Geographical Survey of the Territories, Embracing Colorado, Being a Report of Progress of the Exploration for the Year 1873," Hayden stated that "... The prospect of its rapid development within the next five years, by some of the most important railroads in the West, renders it very desirable that its resources be made known to the world at as early a date as possible." It was Hayden's seventh annual report and the first year that "Geographical" was a part of the title.⁴ By this time, Hayden occupied a well-established position both in the West and in Washington. His work was his passion and he had become adept at getting Congress to see things his way.

Washington Visits

During the time Hayden spent in Washington he was a frequent visitor at the home of his friend Robert Marshall Johnson, the president of the Metropolitan Iron Works. Hayden enjoyed his visits with the Johnson family, and so, especially, did one of Johnson's sons, Frank.

Frank Minitree Johnson, born on November 4, 1872, was fascinated by Hayden's experiences. From the time he was a small boy, Frank listened avidly to Dr. Hayden's adventures. He asked endless questions about the work and never seemed to tire of hearing of the days of danger and discovery that were part of Hayden's life. He was equally impressed with the explorer-surveyor's commitment to his work. His talks with Hayden instilled in young Johnson an interest in the exacting but exciting work of surveying. Hayden's historic exploration of the Yellowstone, his rides through Colorado's San Luis Valley, and his pictures of such things as the ancient cliff dwellings along the Mancos River were certainly fuel for a boy's imagination, but beyond that there was the inspiration of this visionary man of science whose intellect and drive had made him one of the giants of his time.

Geological Survey

In the 11 years from 1867 until the various geological surveys were consolidated by the creation of the United States Geological Survey in 1879, Hayden's survey accomplished the popularization of the Great West. It gave easterners a new, vital, and more accurate picture of the

western scene while fulfilling its basic function of mapping the West and providing the foundation for a good deal of our knowledge of the natural history and topography of the region. Hayden, who was appointed geologist of the Montana division of the new U.S. Geological Survey, remained active until 1886 when illness forced him to resign. When Dr. Hayden died in 1887, Frank Johnson was 15 years old. All his life he would remember not only Hayden's tales of adventure, but his dedication and his pride in his work.

THE OPENING OF THE WEST

Until after the Civil War, the High Plains country was looked upon as the Great American Desert. With the advent of the railroads and homesteaders, it was presumed that the area would soon be settled, but the main result was conflict. As the railroads reached the plains, cattlemen moved their herds northward from Texas to meet the rails. "Nesters," who wanted to fence and farm the land, were in conflict with the cowboys who wanted the whole area from Texas to Canada to be declared open range. Both were in conflict with a third group—the Indians. An enormous part of this region was Indian land and, therefore, was not available to either the cattlemen or the homesteaders.

Dawes General Allotment Act

By 1887, pressure to open more land to survey and for settlement had resulted in passage of the Dawes General Allotment Act (Act of Feb. 8, 1887, 24 Stat. 388). Under this act, individual Indians were granted allotments (which they could sell once they had clear title), and the "surplus" Indian land could be purchased by the United States. The land could then be surveyed and disposed of in the same manner as other public land. As portions of the ceded land were surveyed and opened to settlement, a series of land "runs" took place in 1889, 1891, 1892, 1893, 1895, and 1901.

During these years there was speculation about the merit of combining scientific and public land surveys, and, in 1895, the U.S. Geological Survey began the surveys—both topographic and cadastral—of the recently ceded lands of the Five Civilized Tribes in Indian Territory.

Field Examinations of Surveys

The various surveyors general were responsible for examining surveys in the field in their respective districts until July 1881, when a system calling for

the examination of plats and field notes in the office of the commissioner was inaugurated. Under the new system, each surveyor general still approved the surveys in his own district, even though he no longer examined surveys in the field. The approval consisted of little more than a comparison of field notes and plats so that any discrepancies could be corrected. This was because, no matter how diligently the field notes and plats were checked in the office, there was no way to tell whether or not the actual lines surveyed and monuments established on the ground were as represented in the survey returns.

In his report of October 25, 1881, the commissioner urged that funds for the field examination of surveys be disbursed by his office. He recommended that the system be changed so a deputy surveyor would no longer be expected to examine the surveys of other deputies who would, in turn, examine his work, as had been true in the past. Instead, under the recommended system, experienced surveyors would be employed as examiners of surveys and would be directly responsible to the General Land Office, not to a surveyor general.

Such field examinations were put into effect about 1882 and, beginning shortly after the establishment of a career Civil Service in 1883, all examiners of surveys were hired directly by the GLO under Civil Service regulations.

FRANK M. JOHNSON

Johnson's Early Career

In September 1895, Frank M. Johnson, finally out of school, reported for work as an axeman for a field party working north of the South Canadian River not far from present-day Calvin, Oklahoma. Johnson arrived in the West when painted and feathered Indians could still be seen strolling about in their blankets, beads, and buckskins. However, it was a time of unbelievably swift change. Oklahoma City was only 6 years old, but in that short time it had grown from a handful of tents and shacks into a bustling metropolis of frame houses, stone banks, and multi-storied business buildings. By 1910, Oklahoma and Indian Territories had populations of 790,301 and 107,658, respectively.¹⁵

Johnson was well prepared when he applied for temporary work with the Geological Survey. He had attended the prestigious Corcoran Scientific School of Columbian (later George Washington) University, where he had excelled in mathematics and was active in athletics. Johnson was not only a

good student and a zealous athlete, he was also a mathematics instructor for two years, and he had the foresight to work for various engineering firms during the early 1890's, while he watched for a chance to go West.

His training, experience, and enthusiasm for hard work impressed his superiors in the U.S. Geological Survey. Soon he was advanced to the position of assistant topographer, then to transit work, and, within a few short months, he had become a surveyor in charge of field parties making public land surveys. During the next few years, Frank M. Johnson surveyed in nearly all of the "Five Nations."

When the field work ended, Johnson completed the necessary office computations and, on November 30, 1898, he resigned from the Geological Survey. His experience in public land surveying prompted him to take the regular Civil Service examination for examiners of surveys and he thus began his career with the General Land Office the following March.

Arthur D. Kidder

When the field season in Colorado and New Mexico ended in 1900, Johnson returned to Washington. There he met a young scientist and engineer named Arthur Dale Kidder. Kidder, born on March 26, 1876, had graduated with honors from a course in civil engineering at the Rose Polytechnic School in Terre Haute, Indiana, the previous year. He was a serious and scholarly young man with a great interest in astronomy and surveying. Kidder had been appointed to a position in the General Land Office in July 1900, so he had been there only a short time when he and Frank Johnson first met.

In April 1901, Johnson took charge of the completion of the subdivisional surveys in the Indian Territory, including those in the Wichita Mountain Area (now the Wichita National Forest and Game Preserve in southwestern Oklahoma). Arthur Kidder was his associate on that survey and, later, on the survey of three townships in what was then the Kiowa and Comanche Indian Reservation, prior to the opening of that land to homestead settlement. During the execution of these surveys, Johnson and Kidder became close friends. Although they were very different in temperament and personality, they found they worked well together. They were both dedicated young men and they learned to have great respect for each other. It was the beginning of an association they both were to value for the rest of their lives.

Johnson's Diversified Experience

During his 6 years as an examiner of surveys, Johnson had worked mostly in the Rocky Mountain area. He surveyed, examined surveys, made engineering investigations, and compiled special reports. In his travels, Johnson met a lot of the "old-timers" who had been instrumental in shaping the history of the region, and, in the process, he developed a life-long interest in the history of the American West. The regions where Johnson worked were extremely diversified—broad valleys, level plains, high plateaus, rugged mountains, and deep canyons—and the types of cadastral surveys were just as varied. It was work that enabled him to gain an unusually good understanding of the surveying practice of the General Land Office. He also gained an understanding of the legal phases of the work, the need for a general improvement, and the practical limitations that were always to be confronted.

Usually, Johnson's winter months were devoted to administrative assignments in the Washington office where he met several influential men. At that time there was a great demand for surveys, so it became a period of increased direct contact between the administrative branches of the GLO and those engaged in field operations.

In 1904, word came that the Shoshone Indian lands in Wyoming were to be subdivided before they were opened for settlement. This work was to be done by private surveyors under contract according to the system that had been in effect since the beginning of the public land surveys. It was a large project and, in April 1905, Johnson resigned from the GLO and opened his own engineering office in Cheyenne, Wyoming. As a U.S. deputy surveyor, Johnson contracted to make the subdivisions of the Shoshone lands. When that work was finished, he contracted to resurvey lands within the Union Pacific Land Grant. He also made subdivisional resurveys and determinations of the boundaries of lands which had been patented to private owners. He continued to survey in Wyoming until 1910.

During these years when he was busy with both private and public land surveys, Johnson gained valuable surveying experience. He also gained a reputation for being able to settle differences about the limiting boundaries of the land held by stockmen and settlers. Some of these long-standing disputes were potentially violent, and their settlement required more than familiarity with surveying problems; it required the ability to understand people. Johnson possessed the talent

of being able to instill confidence in the soundness and impartiality of his decisions.

CONTRACT SYSTEM ENDS

During these early years of the 20th century, public land survey work moved gradually into more mountainous, rugged, and less accessible country. At the outset, the contract system had worked well, considering the instruments used and the fact that the surveys were always on the farthest edge of the developed land. Now, however, it became increasingly difficult to get contractors to survey in the roughest areas. In such areas, many conscientious surveyors found that they could make no profit when they surveyed according to the law and their own high standards. Some of them went broke trying. Others simply refused to contract for such surveys.

A few contract surveyors found the only way they could survive and pay their men was to take an occasional shortcut. For example, in subdivisional work the basic requirement is that all lines must be within both rectangular and cardinal limits. A knowledge of the condition of the previously surveyed township boundaries is thus required. This information can be obtained in only one way: the surveyor must retrace the previously surveyed lines. Deputy surveyors were not paid for such retracements so, in rough and mountainous areas, some of them were merely cursory. The result was an occasional survey that was not executed strictly according to regulations. When evidence of such shortcuts, or of poorly made or erroneous surveys, was found, it became apparent that the contract system had outlived its usefulness.

THE BEGINNING OF THE DIRECT SYSTEM

Prior to 1910 there were several knowledgeable and active proponents of a system under which public lands surveys would be made by surveyors hired directly by the Federal Government. Charles L. DuBois, Norman B. Sweitzer, Arthur D. Kidder, and Frank M. Johnson were among those who were most outspoken about the many advantages and efficiencies to be gained by the adoption of such a system.

On June 25, 1910, Congress passed the 1911 Appropriations Act, authorizing the inauguration of the direct system of surveys effective July 1, 1910. Thus, Frank Johnson, who was appointed U.S. supervisor of surveys, and Kidder, who acted

as U.S. surveyor and supervisor,³⁶ were given the chance to prove their point. They were to supervise the new cadastral surveying organization.

First Direct System Survey

On July 14, 1910, Special Instructions for Group No. 1, Colorado, were approved. Assignment instructions to execute the retracement of certain exterior lines and the subdivision of fractional Township 14 South, Range 100 West, Sixth Principal Meridian, were then issued to Albert C. Horton, Jr., a former examiner of surveys. Horton immediately went to the field, near White Water, Colorado, and began official work on the survey. The returns were filed in short order, and the survey was approved by Timothy O'Conner, surveyor general for Colorado, on September 30, 1910.

Later, Johnson frequently told cadastral surveyors about this survey. He always insisted that the extraordinary efficiency and speed shown by the survey crew under Horton was responsible for the overwhelmingly favorable reaction to the direct system from the Department of the Interior, the Congress, and the public. All newly appointed U.S. surveyors and transmitters were encouraged to emulate the efficiency of Horton's crew.¹⁵⁹

When the survey of Township 14 South, Range 100 West, was completed in 1937 under Group No. 297, Colorado, all the Horton corners were found. The first survey completed and approved under the direct system was found to be acceptable in its entirety.¹⁵⁹

The Idea Behind the Direct System

The idea of the direct system was not a new one; on December 23, 1894, in his second annual message to Congress, President Cleveland stated:⁹⁴

The suggestion that a change be made in the manner of securing surveys of the public lands is especially worthy of consideration. I am satisfied that these surveys should be made by a corps of competent surveyors under the immediate control and direction of the Commissioner of the General Land Office.

Even though this suggestion did not become law until 16 years later, no guidelines had ever been established for organizing the scattered, highly independent men who were experienced in executing public land surveys into a cohesive surveying corps with uniformly high standards.

Early Problems

In fact, Johnson and Kidder quickly discovered that in 1910 there was not even a permanent survey office in Denver. It was only after some time and some discussion that they were permitted to hire a part-time "typewriter," as typists were called in those days.¹⁵⁰

Johnson and Kidder also discovered that there was an expanding need for surveys to accommodate the swift settlement of the land then taking place. And then there were all the complicated, isolated, fragmentary surveys upon which no qualified surveyor had dared to stake his reputation under the contract system waiting to be done. Meanwhile, the need for resurveys—particularly in Colorado, Wyoming, and Nebraska—was rapidly becoming urgent.

Under the new system, all surveys and resurveys pertaining to the public lands were to be made by surveyors who were employed directly by the GLO under Civil Service regulations. The roll of U.S. surveyors who were eligible under Civil Service regulations was formed from the former list of U.S. examiners of surveys. One or two of these men were already in the field examining current contract surveys—work that had to be done. Several well-qualified contract surveyors who might have passed Civil Service examinations were already busy executing surveys under contracts that had been signed prior to the creation of the direct system. This meant that there were only 10 or 12 U.S. surveyors actually available in July 1910 to meet the immediate and enormous need for surveys and resurveys.

It is to the credit of both Johnson and Kidder that they did not allow these pressures to force them into following the sketchy plan that originally had been contemplated. That idea, apparently, had two supervisors in the field organizing survey parties while simultaneously trying to promote field work uniformity and efficiency.

One Supervisor of Surveys

Even though the law (36 Stat. 1416) provided for two supervisors of surveys, both Johnson and Kidder realized that neither economy of operation nor efficiency of service to the public would be served under divided authority. Both were too wise in the ways of double survey parties to allow the new organization to stumble into the pitfall of confused responsibility. (In a double party there are two surveyors; each runs a surveying crew. However, in order to ensure a well-coordinated

Surveyors occasionally had problems reconciling the directives of the General Accounting Office with the realities of their unusual line of work. For example, in 1922 the GAO sent out a statement to the effect that the purchase of drinking water was not permitted without a certificate from the local board of health, or a reliable analysis stating that the water was impure or unwholesome.

A. C. Horton took exception to the directive. Out in the desert where his men were working it was not a matter of impure water; it was a matter of no water at all. As he put it, "Occasionally during the progress of our cadastral work we encounter, on the desert, cattle holes and other stagnant pools, which we are only too glad to find and the water from which we use without cost. However, in most instances we are obliged to buy the water."¹⁸

surveying operation and keep the lines of authority from becoming blurred, only one is designated party chief; the other is his associate.)

Almost from the beginning of the direct system it was clear that, of the two men, Frank Johnson was the stronger organizer and administrator. Along with a superior technical knowledge, he had an unusual capacity for dealing with the public, the authorities in Washington, and the personnel of a growing staff.

Kidder, much more the scientist, freely gave Johnson credit for the success of the organization of the surveying service under the new system. In turn, Johnson was openly appreciative of Kidder's particular talents and contributions. The roles they adopted were complementary rather than competitive. Kidder, acknowledging Johnson's greater administrative capabilities, acted as his associate. Virtually from the start, then, Johnson was the U.S. supervisor of surveys.

Johnson brought a certain flair and zest to the role. He knew Washington politics, cadastral surveying, and surveyors. He was at his best in dealing with the large scope of his new responsibilities. Aside from that, he had a thorough grasp of the legal basis of the public land surveys. All his energies were dedicated to the improvement of those surveys under the direct system. He approached the task with a view to creating a surveying service that would be both technically excellent and administratively sound.

Johnson was highly esteemed by officials and by the men of the surveying service. It was Johnson's personality and drive that molded the character of the cadastral surveying service, and for nearly 34 years he gave it both form and direction. Under his careful guidance and due in large measure to his knowledge, understanding, and encouragement, the surveying service kept pace with advances in the art and science of surveying.

Kidder's Role

Johnson and Kidder agreed at the outset that the work was to be carried out in accordance with the

highest technical and scientific standards; and, in so doing, Kidder gained wide public recognition through his knowledge of the theory, construction, and use of surveying instruments, and his work on various publications, including both the 1930 and 1947 Manuals. His surveys and resurveys in the Eastern and Southern States were intricate in character and frequently involved considerations such as mineral or riparian rights. Kidder spent much of his career as a boundary commissioner and surveyor. Over the years his surveys settled disputes that involved land worth many millions of dollars. He contributed a great deal to the science and art of surveying, and in so doing he achieved an enviable reputation as a scientist and surveyor. The academic world took note, and his services as a speaker were frequently in demand.

In the matter of surveying, Kidder's standards were as high as Johnson's. It was Kidder who revised the earlier tables used by the U.S. Government in observing the position of the Sun, the North Star, and other selected stars. These computations were then arranged in the form of the present statistical tables technically called the ephemeris. Though it was first published in 1910 to meet the needs of the new surveying service, Kidder continued to prepare the ephemeris annually until 1944. Still published annually, the ephemeris aids surveyors in establishing astronomical bearings for the determination of the directions of their survey lines.

Kidder also calculated and compiled the "Standard Field Tables and Trigonometric Formulas," which was also published in 1910 as an aid to surveyors under the new direct system. It proved its usefulness and is currently in its eighth edition. Cadastral surveyors have become so familiar with the small maroon-bound volume that they almost never use its long, impressive title; they refer to it simply as "The Red Book."

The New Organization

Johnson, quick to recognize and acknowledge merit in others, rapidly gathered around him a

corps of competent surveyors. A number of men hired under the new organization were drawn from the ranks of contracting deputy surveyors who had been engaged in western surveys prior to 1910. There were a few who had specialized in public land surveys but there had been, for the most part, no continuity of employment. Initially, surveyors were detailed to whatever area in which surveys had to be made, and were furloughed without pay after their field notes were written.¹⁶⁰ Obviously, if good surveyors were to be retained, this system had to be changed.

The size of the area under his jurisdiction (Alaska to Florida, inclusive) prompted Johnson's first major move—to divide the country into surveying districts. Men who had been examiners of surveys formed the nucleus of a supervisory corps. They were assigned to the various districts as assistant supervisors of surveys. Each assistant supervisor was permanently assigned a group of surveyors to take care of the surveys within his district, though, when needed elsewhere, they were detailed to other districts or to the headquarters office. Kidder, as Johnson's associate, was placed in charge of the Eastern States district on much the same footing as the assistant supervisors.

In the early years of the direct system, the assistant supervisors of field surveying districts were as follows:

District No. 1, Montana: J. Scott Harrison
District No. 2, Wyoming and Colorado: Herman Jaeckel
District No. 3, Nebraska and South Dakota: N. B. Sweitzer
District No. 4, New Mexico: A. E. Compton
District No. 5, Arizona and California: A. C. Horton, Jr.
District No. 6, Utah and Nevada: Geo. D. D. Kirkpatrick
District No. 7, Idaho: Frank S. Spofford
District No. 8, Oregon and Washington: Ernest P. Rands
District No. 9, Alaska: John P. Walker

Indian Land Surveys

At the beginning of the direct system, all surveys on Indian lands were executed under the direction of F. A. Dunnington, topographer in charge of Indian surveys. In 1916, however, Dunnington was transferred to a clerical position in the GLO and the commissioner directed that all Indian land surveys were to be done under the general surveying organization of the GLO. The surveyors and transitmen of Dunnington's group were detailed to

work under the direction of the assistant supervisor of surveys of the district in which they were currently working. It was assumed that they would continue to work on Indian land surveys when necessary, as they were experienced in that type of work.

The camping and transportation equipment used by Dunnington was also to be transferred to the district in which it was situated at the time the transfer actually took effect. It was expected that Dunnington's surveyors would be busy on office work concerning surveys that were already underway until about July 1, 1916. In the meantime, Indian land surveys were to be scheduled and worked on by cadastral surveyors along with regular public land surveys.²⁴

Results

Surveyors, almost by definition, are independent individuals. Under Johnson they worked with a will toward a common goal—the success of the new surveying corps. As supervisor of surveys, Johnson was required to spend some time in Washington each year, and he was well respected there. He also made it a point to keep in touch with the surveying districts and their varying conditions. The assistant supervisors welcomed his visits, as indicated in the following letter:⁴⁹

DEPARTMENT OF THE INTERIOR
GENERAL LAND OFFICE

Portland, Oregon,
March 10, 1912.

Mr. Frank M. Johnson,
Supervisor of Surveys,
Denver, Colorado.

My dear Mr. Johnson:—

I have your note of the 8th inst., advising that you may reach here about the 26th inst., which is indeed good news. There are a good many things I would like to take up with you in connection with survey matters.

Now as to when the rainy season ends will say that it was here when I arrived in Oregon forty-three years ago and hasn't ended yet. However, we still have hopes.

Yours very sincerely,

E. P. Rands,
Asst. Supervisor of Surveys

REGULATION IRON POSTS

Under the Act of May 27, 1908 (35 Stat. 347), a regulation iron post was adopted for monumenting the public land surveys. Until then, the identifying corners—the vitally important markers which made up the physical ground record of the surveys of the public lands—were made of whatever materials were at hand. Often these materials were wood posts, or sod or stone mounds. The wood was subject to deterioration and the sod could flatten. Stones, if well marked, were extremely durable, but unfortunately not everyone recognized a marked stone as a corner of a public land survey. Settlers sometimes destroyed them without knowing their value.

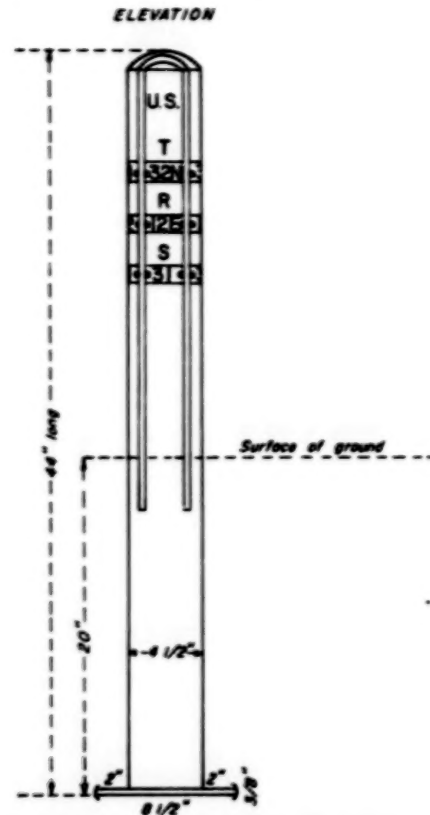
In the Land Office Report of 1880, the surveyor general of California, Theodore Wagner, stated that it was a "matter of surprise" to him that action had not been taken long before, toward a "system of monumentation calculated to perpetuate the corners of the public surveys." He noted that many of the corners that had been established a comparatively short time before were already obliterated. He made strong recommendation that "iron monuments . . . be used to mark the corners of the public surveys . . . at as early a date as possible."¹

With his recommendation he sent a detailed description and a drawing of a design for a metal marker. He estimated that in San Francisco it would cost \$6.25, including the township, range, and section plates, and the screws to attach them. The marker was to be $4\frac{1}{2}$ inches in diameter and 44 inches long, with a heavy extended base, of metal three-eighths of an inch thick. Wagner estimated it would weigh about 80 pounds.¹³⁴

Even though Wagner was right about the need for a standard metal marker, surveyors agree that it is a good thing a less cumbersome one was finally accepted. More than 20 years passed before the General Land Office finally asked that a metal marker be devised. It had to be of a size that could be carried, easy to install, and economical to manufacture. Most important, it had to last.

After experimentation, the marker finally evolved into the regulation iron post now in use. It is a 30-inch long, wrought-iron, zinc-galvanized pipe. Its inside measurement is 2 inches, and its base is flanged so it can be firmly

THIS DESIGN APPEARED IN THE 1880 GENERAL LAND OFFICE REPORT



anchored. Regulation posts weigh about 12 pounds and have a brass cap securely fastened to the top. These brass caps are inscribed with information identifying the corners they mark.

It is thought that brothers John and Scott Stewart set the first of the many thousands of these posts that now mark the surveys of the public lands. Their survey area was near Green River, Wyoming.

The assistant supervisors of surveys had fairly frequent contact with Johnson and the authorities in the Washington office. They understood the aims of the organization and the importance of the surveys.

Johnson's faith in the superiority of the direct system over the contract system was justified even in the first year of its existence. The best surveyors available had been hired "solely upon their past record for efficient services." Most of the new force was composed of men who had been employed before by contract surveyors "whose work had

been passed upon and found correct by examiners of surveys." The surveys of this first year resulted in a savings of \$5 per mile, and the work was above reproach.¹³⁴ In early 1913, in recognition of the way the organization was already operating, the commissioner of the General Land Office officially designated Frank M. Johnson as chief supervisor of surveys and Arthur D. Kidder as associate supervisor of surveys.⁴³

Johnson counted on his men and he was straightforward in his dealings with them. They responded with hard work, respect, and admira-

tion. He rarely gave orders as one would to employees. Still, his pleasant manner was seldom misunderstood; the surveyors knew he would brook no slipshod surveying practice or shirking of their jobs. By the same token, they also knew that he would back them up if they were right, or that if an honest error occurred, they would be assisted in correcting it. Gradually, surveyors who did not measure up to the high standards set by Johnson were weeded out of the service. By 1915 the surveying force had been built up to 160 chiefs of field parties.

By then, most of the surveyors were young men who had gained their skills under the direct system. The fact that several of them had become effective party chiefs was a particular source of satisfaction to the supervisor of surveys. The high morale and the wholesome friendly rivalry between districts and between survey parties also pleased Johnson. In 1916 he wrote (with pardonable pride) that he knew of " . . . no field service of the Government or anywhere else where more effective hard work is done than in ours."⁴³

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ABOUT CADASTRAL SURVEYS

THE BASIS OF CADASTRAL SURVEYS

Cadastral surveys deal with one of the oldest and most fundamental facets of human society—ownership of land. They are the surveys that create, mark, define, retrace, or reestablish the boundaries and subdivisions of the public lands of the United States. They are not at all like scientific surveys of an informative character, which may be amended due to the availability of additional information or because of changes in conditions or standards of accuracy. Although cadastral surveys employ scientific methods and precise measurement, they are not based upon science, they are based upon law. Cadastral surveys cannot be repudiated, altered, ignored, or corrected; the boundaries created or reestablished by them are unchangeable so long as they control rights vested in the lands affected.

The official record of the field work of a cadastral survey ordinarily consists of a plat and the field notes, both of which must be approved by proper authority. A plat, as used technically by the BLM, is a drawing that represents the particular area included in a survey (such as a township, private land claim, or mineral claim) and the lines surveyed, established, retraced, or resurveyed. It shows the direction and length of each of the surveyed lines; the relationship to the adjoining official surveys; the boundaries, descriptions, and area of each parcel of land subdivided; and, insofar as is practicable, the relief and improvements within the limits of the survey. Field notes are the official written record of the survey, certified by the field surveyor. Originally transcribed by hand, they are now typewritten.

In general, cadastral surveys are based upon the intent of the 1785 Land Ordinance, which established the rectangular system of surveys. Much information concerning the various subsequent amendatory statutes, the regulations and instructions required by the laws, and the various applicable court decisions may be found in volume 43 of "United States Code Annotated."

All cadastral surveys (including resurveys or other officially approved actions that result in modifying or changing the record of the original survey) contain three basic elements:

1. The initiating documents, including:
 - a. A written request with proper justification

- b. The Special Instructions
 - c. The Assignment Instructions
2. The actual field survey and the preparation of the official records of the field work
3. The official approval process, including:
 - a. The required filing
 - b. Any required publication

Years after a survey has been officially accepted and approved, the initiating documents of the survey often prove to be a critically important part of the survey. The written request for survey is the basis for determining the validity of the survey and whether or not the survey is authorized by law; it initiates a chain of official action.

The Special Instructions cite the pertinent authority, the appropriation or other funding, the nature of the work to be performed, and specific instructions for the survey that may not be covered in the current "Manual of Surveying Instructions."

Assignment of a group number is also included in the Special Instructions. Since the beginning of the direct system of surveys in 1910, cadastral survey projects authorized under a single set of instructions have been referred to by their group number, for example, Group No. 1, Colorado. Assignment Instructions authorize the responsible employee or employees to execute the work cited in the Special Instructions.

Thus, cadastral surveys are far more than the measurement of lines and angles and the establishment of corners in the field. The results of cadastral surveys are quasi-legal documents that can be obtained only by a series of events in which all these elements are present in their proper order. In the case of *Cragin v. Powell* (128 U.S. 691, 696), the Supreme Court held:

It is a well settled principle that when lands are granted according to an official plat of the survey of such lands, the plat itself, with all its notes, lines, descriptions and landmarks, becomes as much a part of the grant or deed by which they are conveyed, and controls so far as limits are concerned, as if such descriptive features were written out upon the face of the deed or the grant itself.

Cadastral surveys are, in fact, the foundation upon which rests title to all land that is now, or was once, part of the Public Domain of the United States.

SOME PUBLIC LAND STATISTICS

The public lands of the United States date from the time of the formation of the Union. At that time, and soon afterward, seven of the Thirteen Original States ceded to the Federal Government more than 233 million acres of land. Thereafter, through treaties and purchases, the United States acquired another billion acres of Public Domain land. The last of these public land acquisitions was the purchase of Alaska from Russia in 1867. In all, nearly 2 billion acres of land in 32 States—four-fifths of the 2.3-billion-acre gross area of the Nation—have been a part of the Public Domain at one time or another.¹³⁹

At first these lands were sold for the revenue they could produce but, as hardy pioneers moved westward, the revenue-raising policy was changed to one emphasizing the settlement and development of the land. Over the years, title to about 1.1 billion acres of Public Domain land has been transferred to individual citizens, businesses, and non-Federal governmental organizations under the Federal legal authority known as the "Public Land Laws." The Homestead Laws alone accounted for the transfer from Federal ownership of approximately 278 million acres.

Many more millions of acres were transferred to private ownership through military, railroad, and other land grants, including various grants to the States. However, some 715 million acres of the original Public Domain lands remain in Federal ownership—364 million acres in Alaska alone. To this must also be added the 52 million acres acquired over the years for various purposes, thus bringing the amount of Federally owned lands to approximately 770 million acres: roughly one-third of the entire land area of the United States.¹³⁹

Some of these lands have been reserved as National Parks, National Forests, or for other specific purposes, but more than half make up the "vacant and unappropriated" Public Domain. This area—some 450 million acres—comprises the lands under the exclusive jurisdiction of the Bureau of Land Management.¹³⁹

At its maximum extent, the original Public Domain consisted of about 1.8 billion acres—approximately 78 percent of all the land area of the continental United States. Since its beginning in 1785, the rectangular system of surveys has been extended over some 1.4 billion acres of this immense area. At the close of fiscal year 1973, there were more than 440 million acres of public land that had not yet been surveyed. Nearly 80 percent of this total is in Alaska. The remaining

unsurveyed land is situated exclusively in the 11 Western States—almost 4 percent of the total is in Nevada alone.¹³⁹

Many of the surveys of these government lands were executed a century or more ago and the materials used to mark them—wood posts, earth mounds, and the like—sometimes proved to be less than permanent. Time, humans, and the elements have obliterated many of these old survey markers, thus creating an urgent need for the resurvey of more than 50 million acres of land so that the boundaries of the public lands might be properly marked. Resurveys made up nearly 48 percent of the 3.5 million acres of the cadastral surveys that were officially accepted during fiscal year 1973.¹³⁹

RESURVEYS

According to the provisions of law, original corners established during the process of a cadastral survey remain fixed in position, even disregarding technical errors that may have passed undetected before the survey was accepted.

The courts have attached major importance to evidence relating to the original position of the corner, granting it much greater weight than the record relating to bearings and lengths of lines. The corner monument is direct evidence of the position of the corner. Although they are sometimes used as if they were interchangeable, the terms "corner" and "monument" are not synonymous. A "corner" is a point determined by the surveying process; a "monument" is the object or the physical structure that marks the corner point.)

The ground rules for identifying an approved official survey are not exactly the same as those rules under which the survey was originally made. The purpose of a dependent resurvey is not to "correct" the original survey by finding out where a new, or even a possibly more exact, running of the line would locate a certain corner. Rather, the purpose is to determine where the corner was established originally.

Legislation Regarding Resurveys

Resurveys have been made since the early days of the public land surveys. In the beginning, they were made as corrective surveys under the general surveying appropriations when gross errors were discovered. Certain resurveys were later authorized by special acts of Congress. The enactment of general legislation providing for resurveys came about when it became apparent that the lines and



ACQUISITION OF THE TERRITORY OF THE UNITED STATES

corners of many older surveys were becoming so obliterated or distorted that their identification was in doubt.

The Act of March 3, 1909 (35 Stat. 845) as amended June 25, 1910 (36 Stat. 884; 43 U.S.C. sec. 772) authorized extensive resurveys of the public lands in order that they might be properly marked. This 1909 Act, the Act of September 21, 1918 (40 Stat. 965; 43 U.S.C. 733), and the Act of July 14, 1960 (43 U.S.C. 1364) provide the authority for the execution of resurveys of the public lands. The law makes very clear the fact that no resurvey may be executed in such a way that it could impair the rights of the claimants of the lands affected.

The Challenge

Following the passage of general legislation providing for resurveys, surveyors have, from time to time, been assigned the challenging job of retracing lines established by the men who surveyed before them. In all resurveys, the application of legal principles and statutory acts regarding the location of surveyed lines are important and perplexing considerations. The bewilderment and frustration caused by the gradual changes in the execution of the survey system are well known to

anyone who has attempted to "follow in the footsteps" of someone who surveyed more than a hundred years ago, within boundary lines that are not the same as they once were, according to laws and instructions that have changed, and under conditions that no longer exist.

Erroneous Subdivision Rule

Mistaken ideas about correct procedure have also been held by surveyors from time to time. In 1856, for example, even though there was much accurate information available, Thomas A. Hendricks, then commissioner of the GLO, gave the following inaccurate rule for locating the center of a section: "Run a true line from the quarter-section corner on the east boundary, to that in the west boundary, and at the equidistance between them establish the corner for the center of the section."¹⁴

This same erroneous opinion was given earlier by the surveyor general of Missouri and Illinois. The courts did not agree, nor did the GLO in any of its rulings, so far as can be determined. In 1868, this incorrect rule was explicitly set aside by the Secretary of the Interior, but not before it had been followed by a number of deputy surveyors in both Illinois and Missouri.¹⁴

Other Resurvey Considerations

A surveyor must consider several factors when he tackles the job of retracing an old survey—such as the weather, the equipment in use at the time of the original survey, and the mood and disposition the local Indian tribes which may have had a direct bearing upon how a survey was done.

DEPENDENT RESURVEYS

As the need for resurveys grew, so did the realization that the measuring of land is one of the simpler parts of a cadastral surveyor's duty. Often his hardest work is finding the land to be measured. In the past, public lands were often marked with short-lasting monuments. Parcels were sometimes carelessly conveyed. Fences were not always built "on line." At times, corners were inadvertently (and sometimes purposely) destroyed or moved. Time, weather, and the advancing tide of settlement occasionally brought about obliteration of the most carefully established survey monuments.

As a result, cadastral surveyors must consistently perform two related tasks. First, they must define clearly the boundaries of the land they are to measure, and then they must make the measurements. Although the latter requires technical skill and training, it is the former that presents by far the greater challenge.

No two resurvey problems involve exactly the same complications, so there can be no inflexible rules of procedure. Somehow, by experience, training, or instinct—or possibly a combination of all three—cadastral surveyors acquire a certain amount of clear and reliable information about the relative importance of various kinds of evidence, both circumstantial and direct. Frequently they formulate their own methods of finding the line to be measured. Still, their methods are often similar to a marked degree, because, even though they have had differing experiences, the conclusion they all inevitably reach is that the protection of rights in the ownership of land depends not only upon the accuracy of measurement, but also on the reliability of the location of the line. After all, a measurement—no matter how accurate or precise—is of no value whatever if it is in the wrong place.

N. B. Sweitzer

N. B. Sweitzer did much to formulate present-day resurvey procedures. Some of his proposals were foreign to the thinking of his day, but they have become more acceptable as the accuracy and

infallibility of resurveys gained ascendance over matters of volume and speed.¹⁵⁹

During the early years of the direct system of surveys, Sweitzer, as assistant supervisor of surveys for District 3, was faced with some of the early, complicated resurveys in the Nebraska sandhills and the Missouri River flood plain. The main difficulty in the sandhills was the changing contour of the land and the obliteration of survey monuments. The flood plain resurveys had those problems too—and with them other problems that accompany riparian rights and questions of accretion or avulsion.

In a dependent resurvey, the surveyor must restore, in its original position, the original survey by which the lands were patented. But there is more involved in matters of riparian rights. Various maps must be constructed that show the dates of the various movements of the river, and a composite map of all these changes must be made. These movements must be studied so it may be determined whether they were influenced by accretion or avulsion. This is important for the simple reason that avulsion does not change a boundary; boundaries are changed by accretion. But in some of the cases resurveyed under Sweitzer there was still another question—that of the submersion and emersion of land. Each of the cases had to be decided on its own merit, as such cases still must be. Much of the present practice of the recovery of evidence of original corners is the result of Sweitzer's research and the procedures he proposed.

From his hard-won knowledge in such matters, Sweitzer once explained that a surveyor was not really competent to handle resurveys until he had:⁵⁰

at least three years of field experience, as it requires that time for a man to be in a position to authoritatively pronounce whether a corner lost for forty to fifty years in the sandy soil in Nebraska has been found and to understand the technical part of finished resurveys. . . .

Everglades Resurveys

Nebraska sandhills are not the only places where dependent resurveys are difficult. Problems of terrain may differ in various areas, but they are no less problems. The original surveys of the strange and beautiful Florida Everglades were, for the most part, executed in the 1870's and 1880's. Recently, part of this wilderness was resurveyed, and it was found that some conditions had not changed materially in nearly 100 years. The dense un-

dergrowth and cypress trees described by the original surveyors were still in evidence. The muck and water, the scorpions and insects, and the cottonmouth (water moccasin) snakes were also much as the old field notes described them.⁹⁷ Haste in completing a survey might be understood in some of the circumstances encountered by those early surveyors. In one instance, a surveyor named Solee concluded the field note record of his survey in this way: "Water 30 inches deep, insects fierce, snakes all around. Twenty to 30 alligators ahead of me. End of survey."⁹⁷

Independent Resurveys

Independent resurveys are not the same as dependent resurveys. Before an independent resurvey can be run, however, the outboundaries, or limiting boundaries, must be dependently resurveyed. After this has been done, the area within can be independently resurveyed, creating new township or section lines; that is, provided however that all alienated land and bona-fide rights within the area are protected as required by law. These areas are protected by the surveyor who locates them by the best available evidence. This may consist of the land itself as occupied by the claimant or it may be evidence of the original survey.

During the early 1900's, W. R. Bandy executed some independent resurveys in Wyoming in accordance with special instructions issued or approved by W. T. Paine, chief of Division E of the GLO. During the course of these independent resurveys, an entirely new set of section lines was run over land originally surveyed in the 1880's, because some of the earlier surveys had proven to be either erroneous or fraudulent. Private land and valid claims were run out in accordance with corners of the original survey as far as possible—that is, where the corners could be found. The private land and valid claims were given tract numbers beginning with number 37 in each township. Closing corners were set on the independent resurvey lines where they entered and left private lands. Any of the old corners of the former survey that were found, but that did not affect private land, were destroyed.¹⁴⁵

This was done because, as is true in the case of original surveys, the records of resurveys must form a lasting basis for the security of the title to all lands acquired thereunder. If not destroyed, old corners of a cancelled survey remain on the ground and cause confusion. The surveyor therefore had to exercise great care in his field work and in the preparation of the record so that the independent

resurvey would take care of the existing problems without creating new ones.

THE EVOLUTION OF THE "MANUAL OF SURVEYING INSTRUCTIONS"

Various regions of the United States have been surveyed under amended or differing instructions from the passage of the 1785 Land Ordinance to the present. That ordinance gave fairly explicit cadastral surveying instructions, which were to be carried out under the personal supervision of the geographer of the United States, Thomas Hutchins.

His successor, Rufus Putnam, was given the title of "Surveyor General of the Northwest Territory" under the terms of the Land Act of May 18, 1796. By then, the surveys were becoming more complex; half the townships were to be subdivided into 2-mile blocks, and the section numbering system was changed to the one now in use.

Gradually, other laws were passed that called for further subdivision, and the system of rectangular surveys was refined. During these early years general instructions and advice were given to the surveyor general by the Secretary of the Treasury, who was then the highest official directly concerned with the survey and disposal of the public lands. Later this became the duty of the commissioner of the General Land Office. Instructions to the various deputy surveyors were issued by the surveyor general—either in letters or as a part of the instructions accompanying the contract for the survey involved.

A surveyor for the lands south of the State of Tennessee was appointed in 1803. His duties were much the same as those of the surveyor general. Over a period of time, as more land was acquired by the United States, a surveyor general was appointed for each of the public land States and Territories. Each of these officers had a fairly free hand in issuing instructions to the deputies each employed.

There is good evidence that Jared Mansfield, Putnam's successor, issued fairly detailed instructions to his deputies in 1804 when he contemplated the survey of the Vincennes Tract in Indiana. Unfortunately, Mansfield did not sign or date the instructions. The sole proof that he issued them consists of the content of the instructions and the fact that a careful comparison of letters signed by Mansfield and the handwritten, undated instructions shows the handwriting to be nearly identical in all respects.¹⁶⁰

In 1815 Edward Tiffin, who succeeded Josiah Meigs as surveyor general of the Territories east of

the Mississippi, issued the first signed and dated general instructions for the guidance of deputy surveyors, although they were undoubtedly based partially on the instructions issued earlier by Mansfield.

Other printed circulars followed, and in 1831 the commissioner of the General Land Office, Elijah Hayward, issued detailed instructions to the surveyors general concerning surveys and plats. The applicable parts were issued by the individual surveyors general in bound volumes of instructions suitable for use by the deputies in the field.

In 1849, the GLO was transferred from the Treasury Department to the newly created Department of the Interior. However, of much greater importance as far as the surveys were concerned was the Act of July 4, 1836, to reorganize the General Land Office. This act, which placed the responsibility for surveying the public lands in the hands of the commissioner of the GLO, ended the continuing conflict with the various surveyors general.

Under the terms of this act, the overall direction of the public land surveys was placed under the principal clerk of surveys in the General Land Office. The man who held this office for many years, John M. Moore, prepared the immediate forerunner of the present manual series in 1851. It was entitled "Instructions to the Surveyor General of Oregon; Being a Manual for Field Operations." The use of this 1851 Manual was immediately extended to California, Minnesota, Kansas, Nebraska, and New Mexico.

Later, Commissioner Thomas A. Hendricks asked John M. Moore to prepare a slightly revised edition of the Oregon manual. This new edition was issued in 1855 as "A Manual of Surveying Instructions, to Regulate the Field Operations of Deputy Surveyors."

The Congressional Act passed on May 30, 1862 (12 Stat. 409), provided:

That the printed manual of instructions relating to the public surveys, prepared at the General Land Office . . . the instructions of the Commissioner of the General Land Office, and the special instructions of the surveyor general, when not in conflict with said printed manual, or the instructions of said Commissioner, shall be taken and deemed to be a part of every contract for surveying the public lands of the United States.

Revisions of the 1855 Manual have appeared from time to time, as the need has arisen. The 1871 Manual was a reprint of the 1855 edition, followed in 1881 and 1890 by other revisions

The 1894 Manual was written under the direction of Commissioner Silas Lamoreaux by one man, Major Shinn. It was, in Frank M. Johnson's opinion, "a high-class technical work," while the 1902 Manual, written by A. W. Barber, was "a passable rehash of the 1894 Manual" that "served its purpose."⁶¹ This was the manual in use at the beginning of the direct system. However, the appropriation act approved by Congress on June 25, 1910 (36 Stat. 775-997), included \$3,000 to be used toward the preparation and publication of a new revision of the manual. This appropriation was made in recognition of the fact that the problems faced, and the methods used in solving them under the direct system, had not been contemplated in the 1902 Manual.

The new manual was prepared under the direction of the commissioner by a board of experts, one of whom was Arthur D. Kidder. The press of business was such, however, that only the advance sheets of the first six chapters were ready for publication by 1919. This portion of the revised manual was issued to surveyors in pamphlet form in mid-June of that year. Meanwhile, work continued on the remainder of the material to be included in the new manual.

A manuscript edition of the ninth chapter of the revision was issued and became effective on March 1, 1928. The first complete and fully revised instructions for the survey of the public lands under the direct system was finally published as the "Manual of Surveying Instructions, 1930." (This was the first manual to include instructions for mineral surveys. Prior to that time, separate instructions to U.S. Deputy Mineral Surveyors had been issued in 1879, 1889, 1890, 1893, 1895, 1897, and 1909.)

The "Manual of Surveying Instructions, 1947" was published by the General Land Office's successor agency, the Bureau of Land Management, which had been created in 1946. Again, Arthur D. Kidder was instrumental in its preparation.

In 1964, Thomas A. Tillman was selected as one of a four-man team to rewrite and update the 1947 Manual. In the letter officially detailing Tillman to do this work, the director of the BLM stated, "In reviewing the capabilities of the field force for this work, Tom Tillman stands out as one specifically qualified." It was soon apparent that what had been contemplated as an updating project would require a complete revision, along with a revision of the manual supplement, "Restoration of Lost or Obliterated Corners."

Meanwhile, the Washington office was faced with retirements that left it grossly understaffed in the face of ever-increasing demands by other executive departments. Tillman was asked to transfer to Washington to fill this void. In requesting this transfer, C. E. Remington, chief, Division of Engineering, said of Tom Tillman, "He is an avid reader of cadastral history and is the best qualified in cadastral law of anyone in the field."

Although Tillman's primary duty in Washington was the rewriting of the manual, his expertise in questions of cadastral law and surveying techniques interrupted his work on the manual for considerable periods of time while he prepared legal support papers and appeared as an expert witness as requested by the Department of Justice. In rewriting the manual, Tillman achieved one other long-desired result. In 1915, Frank M. Johnson had expressed the hope that the manual then in preparation might be written with simplicity and directness.⁴¹ "The Manual of Surveying Instructions, 1973" meets all the requirements brought about by the many aspects of the interrelationship of technology and law in the execution of cadastral surveys, and it does so in a well-organized and most readable manner.

The manual has been accorded the force and effect of law in many court decisions and is cited in the laws of most public land States as mandatory in the execution of retracement, resurvey, and subdivision survey of patented public land by private surveyors, even though it is issued primarily

for the guidance of cadastral surveyors in the execution of public land surveys.

MANUAL SUPPLEMENTS

There are three supplements to the "Manual of Surveying Instructions, 1973." They are:

1. "Standard Field Tables and Trigonometric Formulas." This supplement was first published in 1910; its eighth edition, in 1956. The tables and data it contains are designed for use by cadastral surveyors in the field and office.

2. "The Ephemeris of the Sun, Polaris and other Selected Stars with Companion Data and Tables." This supplement has been published annually in advance since 1910.

3. "Restoration of Lost or Obliterated Corners and Subdivision of Sections: A Guide for Surveyors." The subject matter presented in this supplement first appeared in the decisions of the Department of the Interior. There have been several revisions and extensions of this work, the latest in 1974. It provides an introduction to the rectangular system of public land surveying and resurveying, along with a compendium of basic laws relating to the system. It answers many questions arising in practical surveying work, and although primarily intended for surveyors outside the Bureau of Land Management, it is also of interest to attorneys and others who have professional interests in former or present public lands.

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1. Est. Gilman
2. Gilman
3. Mary Thomas
4. John H. Hubbard
5. Phoebe Clark
6. Forrest Smith
7. John O. Bates
8. Charley Wilson

9. Joel Q. Naret
10. Ira B. Moore
11. Ellias C. Thayer
12. James E. Pfau
13. Frank Cone
14. George Poore
15. Jack Fisk
16. William P. Holman

17. Thomas F. Mathias
18. John C. VanHook
19. Oliver B. Tomlin
20. Melvin J. Davis
21. Edward Jessup
22. Frank E. Cone
23. Ralph DeCamp
24. Winchester Dickerson

1909



Montana, U.S. Surveyor-General's office clerks, 1909.

114



Around the campfire in 1902, Yellowstone National Park. Frank M. Johnson, examiner of surveys, is standing at the left.



Richard E. (Elmer) Bandy, who joined the Brunt survey party in the early 1900's.

Standing left to right: Grant Dawson, Col. Samuel W. Brunt, and Arthur Brunt. Seated left to right: young Sam Dawson on Mrs. Dawson's lap, Mrs. Brunt, and Mrs. Arthur Brunt and son Bill. (Mrs. Dawson was Sam Brunt's daughter.) Photo was taken near Meeteetsee, Wyoming.



Col. Samuel W. Brunt in camp in the McCullough Peaks, east of Cody, Wyoming, in 1905.



Surveyors pause for lunch on moving day. Note mess-box and Sibley stoves on wagon, and horse (at extreme left) eating from nosebag. Man at left is Sam Hutton; fourth and fifth from left are Elmer Bandy and his wife, Lula; second from right is Arthur Brunt. Photograph taken in Sunlight Basin, Wyoming, in 1907.



Hopi Indian Reservation, Arizona, 1910. Left to right: Ty and Van White. The instrument is a Gurley with a Burt solar attachment.



Survey camp, Garland, Wyoming, June 1905. Standing left to right: Luther Glasgow, "Kentuck" Friday, W. R. (Roy) Bandy, Miss Jones, Willford Utterback (party chief), unidentified, Ernest Strong. Peeking at left: Troy Troutman. Seated left to right: Miss Huber, Sam Hutton, and Rhoda Huber (camp cook).



Roy Bandy's survey camp on the move, Montana, 1921. Note two motor vehicles at extreme right, as well as mule teams and wagons.



Glenn F. Sawyer's survey crew, Missouri River Breaks. Note pack horse at left carrying tools and iron posts.



Guy P. Harrington's outfit shown hauling water to a side camp during Dunnington survey which was begun November 8, 1911. T. 4 N., R. 20 W., Gila and Salt River Meridian, Arizona.



Mess wagon on the move in eastern Montana, 1915.

Inez (Roy's wife) Bandy holding a 3-foot rattlesnake she killed. Wyoming, 1911.



Glenn Sawyer, Missouri River Breaks south of the Bear Paw Mountains, 1918.



Survey camp on the move. Note lanterns tied on the side of wagon, tub lashed to back of rig, benches (packed one up and one down), and what appear to be army-style leggings worn by the man on right.



Early day cadastral survey camp in the Black Hills of South Dakota.



United States public land survey. Devil's Canyon in the Black Hills of South Dakota. This year is about 1914.



William E. Hiester's survey party, August 1927; $\frac{1}{4}$ corner between sections 8 and 9, T. 41 N., R. 3 W., Mt. Diablo Meridian, California.



"Breakfast in the Big Horns." Photograph from an oil painting by Montana artist Shorty Shope. It was painted from a photograph taken on an August morning in 1912. Left to right: Willis Bandy, Roy Bandy, Inez Bandy, and chainmen George Horner and Howard Pitt.



Noon-hour rest for some General Land Office surveyors near Sebring, Florida, in 1918. Hal D. Craig is under the transit.



Supertime in a 1917 survey camp in the mountains of Washington State. C. W. Blocker is on the right; Quintin Campbell is third from right.

*Wash day on a Sunday in
September 1914. The survey
camp is in Fergus County,
Montana.*



*The year, place, and surveyors are unidentified, but the
situation is familiar.*



Surveying in the State of Washington, in 1914.



Setting up camp in the desert. Arizona, 1916.



Chainmen on line. Group No. 33, Oregon, in 1917. L. V. Hoffman, head chainman, at right; H. S. Wersch, rear chainman, at left.



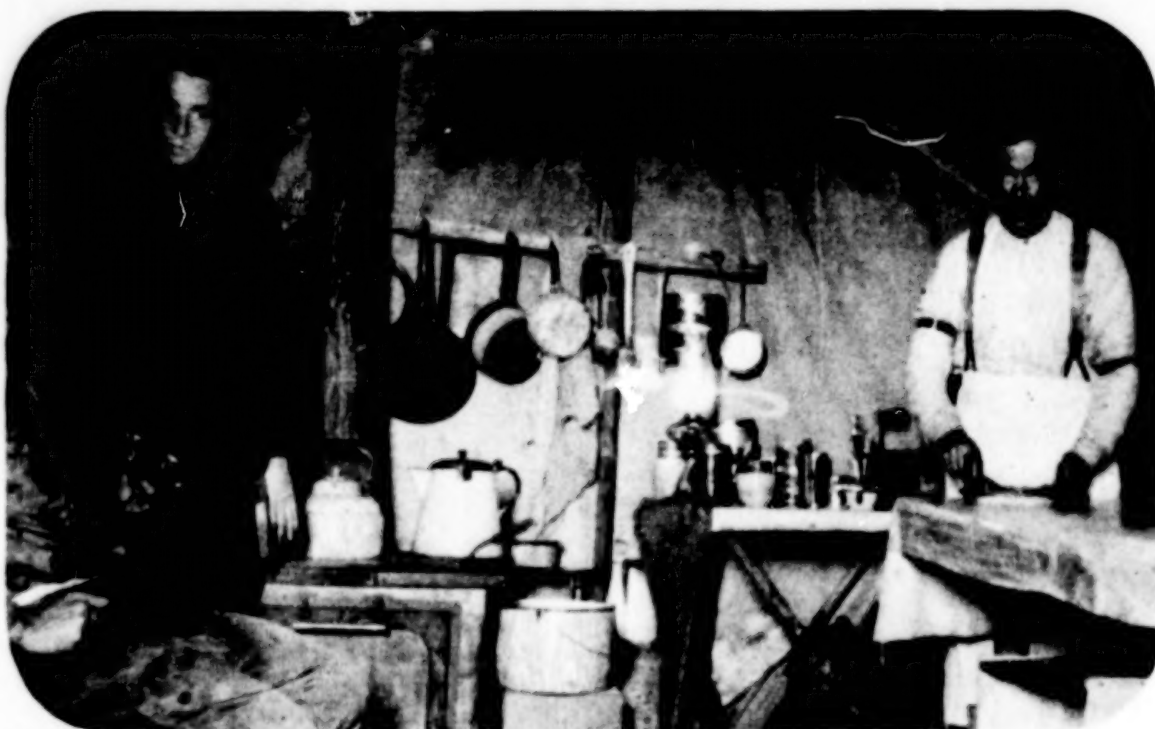
*H. S. Werschul, rear chainman, Group
No. 33, Oregon, 1917.*



Missouri River Breaks, 1918. Art Stensland at the transit.



Roy Bandy's survey camp in the Missouri River Breaks south of the Bear Paw Mountains, 1918. Note home-made water tank (center)—they had to haul the water 15 miles. Also note use of both wagons and motor vehicles.



Interior of cook tent, GLO survey camp, near Wilson, Arkansas, November 1915. Note kerosene lamp providing the light, and William Hiester (at extreme left) eating a big piece of pie the cook has just served him.



*A cadastral surveyor looks at the rough terrain in northern Idaho.
Near Priest Lake, 1911.*



A survey party at work in heavy timber in the area near Gypsum, Colorado, in the early 1920's. Roger Wilson is at the extreme left standing next to Emil Voigt. Hans Voigt is fifth from left.



United States cadastral surveyors in southern Wyoming. The year is not known, but is probably in the late 1920's or early 1930's. The horse was used for carrying iron posts, tools, and lunches.



Moving camp in 1914, Flatwillow Creek, Fergus County, Montana.



Portrait of a surveyor. This one, taken in Arizona in 1917, is of Quintin (Jerry) Campbell.



A beautiful site for a survey camp: T 24 N., R. 13 or 14 E., Willamette Meridian, Washington State, 1914. It is probably Cathedral Rock in the background.



Left to right: Ernest Rands, assistant supervisor of surveys for Oregon; Clay Tallman, commissioner of the General Land Office; and Frank M. Johnson, supervisor of surveys, circa 1914.



Four feet of snow, September 1912, in the Big Horn Mountains, Wyoming. Second from left is Inez Bandy, standing beside the square "office tent."



Moving camp in "the good old days." January 1915, Group No. 41, Arizona.



*Rare 3-mule wagon outfit moving camp. T. 5 N., R. 7 E., San Bernardino Meridian, California, March 1920.
Group No. 62. Quintin Campbell, U.S. Surveyor.*



When trucks or mules could not pack in the equipment and supplies, the men had to fashion water transportation. This photo was taken about 1923.



Bernard (Benny) Lange (on the left) and John Dixon (on the right) on the job in the Smith River area in 1932.



A portion of the double survey party on Belly-Ache Mountain, near Eagle, Colorado, in 1920. The man who is second from the right in the photo is John S. Knowles; to his right is Hans Voight. Kneeling on the ground (first from left) is Roger (Shrimp) Wilson; this was his second season with Knowles' party.



On a weekend morning, surveyors often adjusted the solar attachments on the meridian. The date of this photo is 1925.



In a photo taken in 1912, N. Price is shown with E. Strickler.



These two early surveyors are T. O. Johnson (left), and Ted VanderMeer (right), in early 1917.



Free time in camp in the Cascades in 1923. Bud Kent is the man on the right in the photo; note some of his carvings in the middle background of the photo.



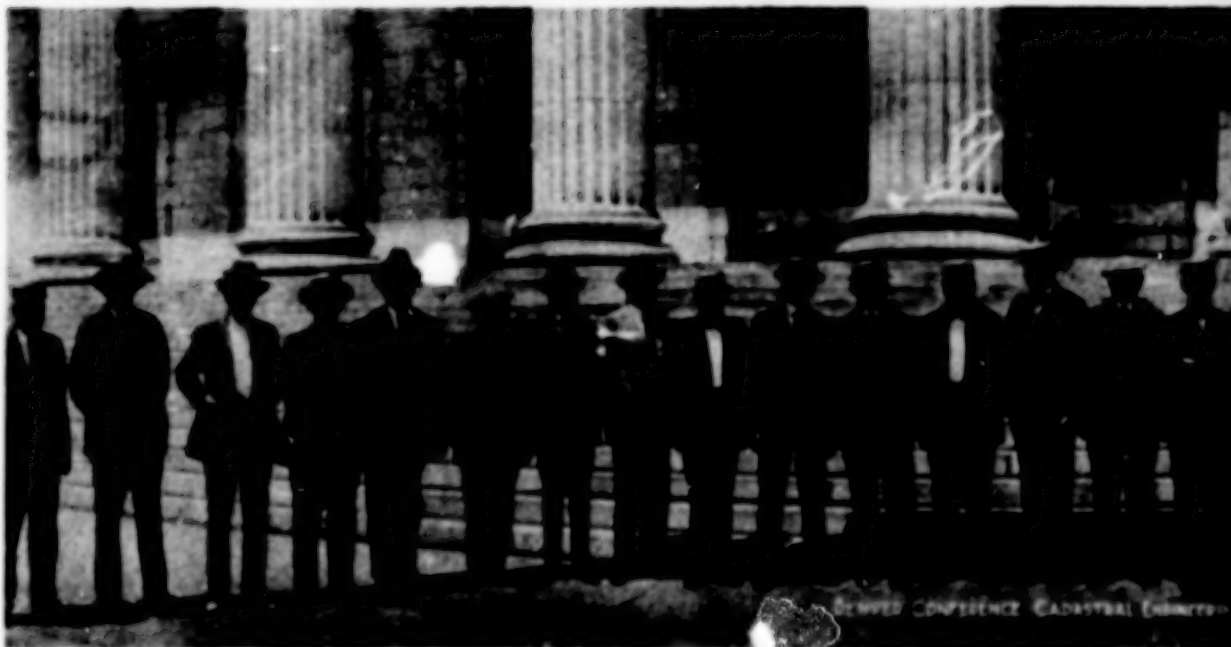
This truck was used by the government at a job in the Smith River area in 1932. The driver is Harvey Russell.



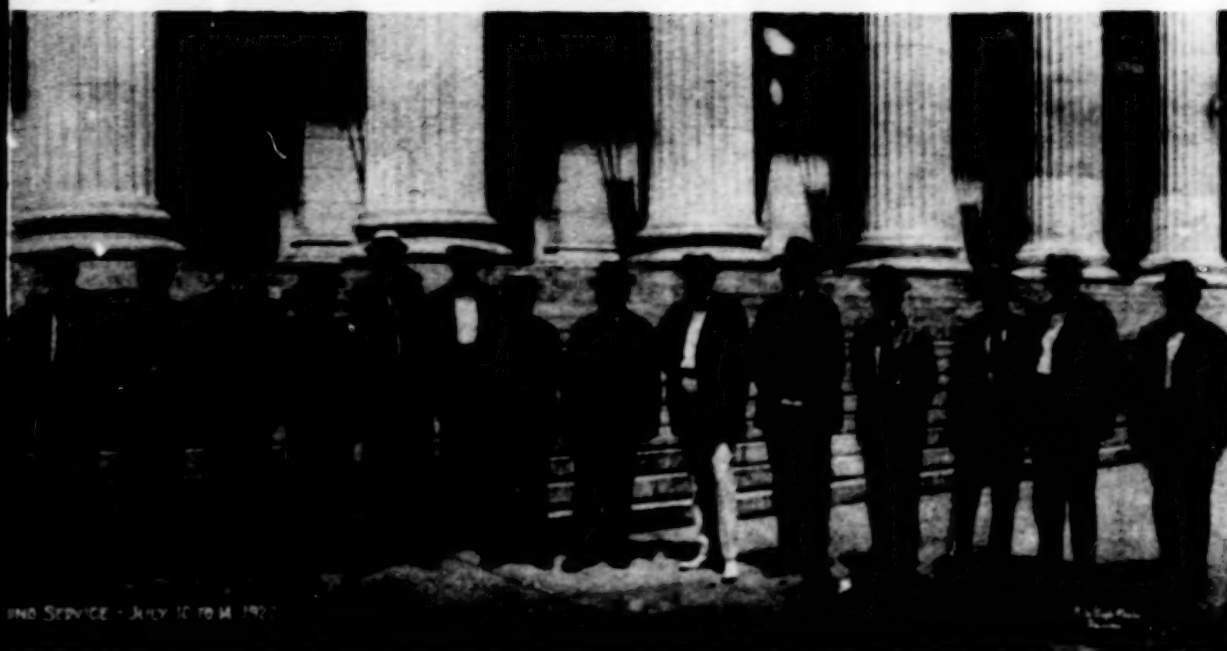
When not near a barber, the surveyors improvised. Here, John English is getting a trim from a friend. The camp is near Amboy, California; the time is 1919.



This photo was taken in May 1911. It shows the starting of the Seward Meridian in Alaska, with John P. Walker on gun. Walker was later the assistant supervisor of surveys in Alaska (1915-1924).



This picture shows those attending the Denver Conference of the Cadastral Engineering Service, held July 10-14, 1923. It is Alonzo E. Compton, J. Q. Naret, H. R. M. Atkinson, Judge William H. Lewis, W. H. Clark, Thomas Mathias, A. C. Horton, Jr., John McCord, Frank S. Spofford, Frank A. Lewis, Ralph W. Nelson, George F. Naden, Guy P. Harrington, Raymond C. Morrison, Goodale, and Ernest P. Rands.



IND SERVICE - JULY 10, 1904

important because so many men pictured are important figures in the history of the Cadastral Survey. Left to right, they are: D. Adams, John W. Rowland, Russell K. Allen, Herman Jaeckel, G. D. D. Kirkpatrick, Norman L. King, J. Scott Harrison, Alan R. Walter T. Paine, N. B. Sweitzer, William Spry, Frank M. Johnson, John P. Walker, Arthur D. Kidder, T. C. Havell, Samuel W.

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ALASKA

Alaska was the last acquisition adding public land to the United States. Although Hawaii later became the 50th State, it had been first a monarchy and then a republic; its formal annexation in 1898 added no vacant, unappropriated public land. In contrast, nearly all of Alaska's 580,000 square miles was Public Domain. There were a few surveyed town lots in Sitka, title to which had been granted by Russia, but most of Alaska was unexplored and unsurveyed upon its entry to the Union.

Alaska reaches northward 1,170 miles through 18 degrees of latitude. It extends from 130° W., past the 180° line and on to 172½° E. (57½ degrees of longitude). The difference in time (3 hours and 50 minutes) from one of these extremes to the other is greater than that between New York and San Francisco. Alaska actually has four time zones—Pacific, Yukon, Alaska, and Bering. It is the only state that crosses the International Date Line. Alaska's Point Barrow is the northernmost point in the United States; the westernmost point (172° 27' E.) is at Cape Wrangell, Attu Island.

Alaska has several high mountains, including North America's highest peak—Mt. McKinley. It has innumerable lakes and nearly 34,000 miles of coastline. The Yukon, Kuskokwim, Copper, and Susitna Rivers, among others, empty some 800 million acre feet of water into the sea each year—about 40 percent of all the fresh water available under the United States flag.

EARLY HISTORY

Alaskan Natives—Eskimos, Aleuts, and Indians—apparently had their own methods of measuring distance and direction and their own ways of allocating area, but more modern surveying arrived in Alaska with the "civilized" men led by Vitus Bering. Alaska's recorded history began in 1741 when Vitus Bering, a Danish navigator in the service of Russia, sailed east from Siberia and landed in Alaska. Bering made preliminary explorations of the southwestern coast of Alaska, the Alaskan peninsula, and the Aleutian Islands.

Though the reports of Bering's expedition contained information that should have been greeted as a great contribution to man's knowledge of the geography of the region, they were scarcely used. One fact obscured all the rest—Bering's expedition had discovered the valuable fur of the sea otter.

EARLY EXPLORATION

In 1778 Captain James Cook, an Englishman, sailed through Bering Strait and up the Cook Inlet. His voyage, the first scientific navigation in the area, resulted in some fairly accurate charts.

Then, during the summers of 1792 and 1794, Captain George Vancouver, another Englishman, explored and surveyed the coast of Alaska. For many years Vancouver's charts were the accepted standard. The 1825 Southeast Alaska boundary treaty separating Russian Alaska from English Canada probably was based on Vancouver's surveys.

The English, the Spanish (who had explored Southeast Alaska), and the French (who had explored Lituya Bay) had all voiced claims to various parts of Alaska by the time Vancouver's charts were published. The Russians, who had "discovered" the region and established settlements there, took a dim view of these claims.

ALASKA PURCHASE

When Alaska was purchased from Russia by the United States in 1867, Congress and the press reacted violently to the news that a treaty between Russia and the United States had been signed and that \$7.2 million in gold had been agreed upon as the selling price. Many persons considered Alaska a vast, frozen wasteland and its purchase a foolish expenditure. Others believed Alaska to be an immense storehouse of natural resources and thought it was a wise investment.

Coast Survey Report

When the Senate approved the purchase treaty with only one vote to spare, the administration realized that more information about Alaska was needed. An expedition to supply it was organized under the guidance of the Smithsonian Institution and the Treasury Department, which was in charge of the activities of both the Coast Survey and the Revenue Service. George Davidson of the Coast Survey was chosen to head the small group charged with making a geographical survey of the controversial new territory. By the time he was selected to take charge of the preliminary geographic survey of the new territory, Davidson had gained a wide reputation as a civil engineer, geographer, hydrographer, and geodesist.

In the Congressional debates prior to the passage of the Alaska appropriation bill, many references were made to George Davidson and the Coast Survey Report. The report was apparently successful in influencing at least a few Congressmen to decide that Alaska was worth the purchase price of nearly 2 cents per acre.

1867-1880

The Alaska appropriation bill finally passed nearly a year after the flag of the United States was first raised at Sitka on October 18, 1867. After making Alaska a customs district, Congress seemed to forget about the new territory. No plans were made for its development; no means were provided for the filing of claims or the acquisition of land. There were no means of setting up local governments, nor was there a civil or a criminal code. Military law was nonexistent; soldiers stationed at Sitka had no authority other than that of defending Alaska against attack by foreigners or hostile Indians.

During the next few years the Coast Survey made a few sporadic coastal surveys; but by 1877, when the soldiers left Sitka to fight the Nez Perce Indians in Idaho, there were still no public land surveys. For that matter, there was still no public land law. No Alaskan settler could clear land or build a cabin with any assurance of owning it. No prospector could stake a mining claim with any security. Land could not be deeded or transferred. Wills were not valid. Injured parties could secure redress for grievances only by their own acts. In the matter of crime, gun law prevailed.

Gold and Civil Government

This state of affairs lasted until Joe Juneau and Richard Harris found gold in Southeast Alaska in 1880. This event seemed to awaken Congress to the problems, and, in 1884, by passage of the Organic Act of May 17 (23 Stat. 24), the laws of Oregon were extended to Alaska, as far as was practicable, and a civil governor was appointed. There was still no law governing settlement or public land surveys, but the mining laws of the United States were extended to Alaska. A Federal judicial district was formed with a judge and other law enforcement authorities. One of them, the U.S. Marshal, was also to act as ex officio surveyor general. The following letter explains the duties of that double office:⁸⁵

October 5, 1887 Sitka, Alaska

To the
Secretary of the Interior
Sir:

I respectfully represent that since assuming the duties of Marshal of this district, no business appertaining to my twin office, that of Surveyor General, has until quite recently, been presented, but each mail now brings its full quota of applications for surveys and patents for mineral lands, principally from Juneau, Douglas Island and the Berners Bay District.

I have not, as yet, received a department communication concerning the office of Surveyor General, no instructions in connection therewith, have no blanks, no books of record, and there is none to be had within one thousand miles of my office, and without money to buy them were they at hand. With the duties of the office I have no experience, and what is more serious, the office itself has no emoluments—other than the cursing I get for insisting that the land laws shall be strictly complied with in every instance.

The duties of the Marshal of this district are multifarious and rapidly assuming large proportions. I am custodian of the Territorial prison, crowded with culprits two of whom are likely to require hanging in the near future. I have the care of fifteen prize schooners together with fifteen thousand fur seal skins—to keep from spoiling until they can otherwise be disposed of. At present I am inflicted with an order of the Court to proceed to San Francisco on urgent public business, with the moral certainty that my salary will be confiscated by the Treasury Department should I absent myself from home without consent of the Department of Justice, while public interest does not admit of the delay necessary to procure such consent—two months or more. I am not allowed a clerk at either of my headquarters—180 miles apart; at which places I am often required to be simultaneous.

Therefore Resolved: That a competent clerk is an actual requirement in the office of the U.S. Marshal—Ex-officio Surveyor General, of the Territory of Alaska.

Very respectfully,
Your obed't Serv't

Barton Atkins
U.S. Marshal and
Ex Officio Surveyor General

Hon. L. Q. C. Lamar
Secretary of the Interior,
Washington, D.C.

Surveys Needed

The activities of the Coast Survey, renamed the Coast and Geodetic Survey by the Act of June 20, 1878 (20 Stat. 206, 215), were also spurred by Juneau's discovery of gold. The field work for the triangulation of Southwest Alaska was started in 1882. The U.S. Coast and Geodetic Survey was

responsible for the establishment of geodetic positions that were, and still are, of great value for determining precise positions on the surface of the Earth.

The discovery of another rich gold lode caused a rush to the Klondike region of the Canadian Yukon in 1896. It and the gold rush to Nome, Alaska, two years later, helped to swell Alaska's population and call attention to the need for surveys. Even Congress paid heed, and by the Act of March 3, 1899 (30 Stat. 1098; 48 U.S.C. 351), the principal public land laws, including the rectangular system of surveys, were extended to Alaska.

The rush to the Klondike, adjacent to Alaska, also drew attention to the fact that the location of the boundary between Alaska and Canada had not yet been permanently decided. There had been discussions about it from the time Alaska was first purchased by this country, but it was not until 1904 that both Canada and the United States sent surveyors to mark the boundary line as it had been fixed by a six-man joint commission.

PUBLIC LAND SURVEYS

In 1904 the first contract for an Alaskan public land survey was let. It was for the survey of 12 Mission sites, one of which was in lat. 70° N.⁹⁰ The following year the initial point for the Copper River Meridian system of surveys was established. Its latitude and longitude were determined by reference to the Coast and Geodetic Survey triangulation net. From this initial point, A. B. Lewis, a U.S. deputy surveyor, surveyed 12 miles of the Copper River Base Line, 72 miles of the Principal Meridian, 72 miles of the Third Standard Parallel North, and 36 miles of the First Guide Meridian East. The first township subdivision survey in Alaska was executed in 1910 by Thomas A. Haigh, a 38-year-old U.S. deputy surveyor from Michigan.⁹⁰

USGS Experiment, 1910

About the same time the direct system of surveys went into effect, the U.S. Coast and Geodetic Survey determined the geodetic position for the initial point of the Fairbanks Meridian and Base Line. For some reason, the first survey from this position was not executed by GLO surveyors. Instead, the U.S. Geological Survey ran the first 18 miles of the base line, 24 miles of the Principal Meridian, and several township exteriors.⁹⁰ However, instead of surveying lines directly from astronomic observations, they used geodetic control data to establish and adjust the rectangular system.

Tenana Valley, 1911.

The unsuccessful experiment was short-lived, and in 1911, a double party of GLO surveyors under W. H. Thorn, U.S. surveyor, connected subdivisional lines to the exterior township corners thus established, first replacing wood post monuments with iron posts wherever necessary.⁹⁰

It took a dedicated man to handle surveys such as those near Fairbanks in the Tenana Valley in 1911. There were problems to overcome in tying to the Geological Survey markers and extending the rectangular surveys. In fact, just getting to the area presented problems, as Thorn explained in a letter to Frank M. Johnson:³⁸

I am getting along slowly. Had a hard time getting in. Mushed over the ice on Lake La Barge. The boat I was on struck a rock and sunk thirty miles below Lake La Barge May 21st. Then we were picked up by the Steamer Pauline and it nearly sunk twice before we got to Dawson. Had a good trip from Dawson to Fairbanks.

My! we had a hard trip over the ice. Laid out without shelter three nights, and the lake ice, in places, was just like walking on a blanket. Pulled our stuff across on sleds. Could not get dogs to haul the baggage. I certainly was all in when I got to Lower La Barge. There were about two hundred came in on the ice. It certainly was a dangerous trip. From White Horse we floated down to the lake in a barge. It cost me \$17.00 extra to get over the Lake or get down to it. If I had waited for navigation, it would have been much later, for the ice did not go out until the 8th. I got in here nineteen days ahead of the first through boat. . . . I was just a month on the way from Seattle to Fairbanks.

Seward Meridian

The same season that Thorn worked in the Tenana Valley, a similar double party under J. Frank Warner extended the surveys governed by the Copper River Meridian and Base Line and a third double party, under John P. Walker, inaugurated the system of surveys under the newly adopted Seward Meridian and Base Line. Walker's party was not troubled by snow and ice; they had a different set of problems, according to a letter Walker wrote:³⁸

The mosquitoes and bugs of all classes have fully come up to expectations this summer and are the curse of this country.

I met a big brown bear on line Aug. 2nd with a rather pugnacious disposition and we had rather a close call, but by the aid of a few small threes and a little brisk climbing we managed to

come out unharmed. I claim the record though for setting up an instrument in minimum time, as I had the instrument on my shoulder when I met the lady on a dead run for me and only about 100 feet away and to set up an instrument on all three legs, drop the plumb bob without pulling the instrument over and climb a tree in one second less than it takes a bear to run 100 feet is going some.

Coal Fields

In 1914, the leasing of coal lands in Alaska was authorized for the first time (38 Stat. 471). This created a sudden demand for a survey of the coal fields, and a special appropriation was made for that purpose. In 1915 John P. Walker was named assistant supervisor of surveys for Alaska, and the survey of the Nenana, Bering River, and Matanuska coal fields became his responsibility.⁴² The only problem in this was that he was expected to complete all three surveys in one short survey season.

In order to get the survey under way, Frank M. Johnson accompanied Walker to Alaska. For two months they worked together, organizing and placing the necessary 15 surveying parties in the field. When this was done, Johnson returned to Denver. Although it was an enormous task and the new assistant supervisor was under considerable pressure, he was able to report before the end of the season that both rectangular and topographic surveys of all three areas had been completed. The plats and field notes were finished during the winter and the coal lands were offered for lease on schedule the following spring.⁴³

George A. Parks

George A. Parks, then chief of the Field Division of the General Land Office in Alaska, assumed Walker's duties as assistant supervisor of surveys when Walker was transferred to Idaho following Frank Spofford's death in 1924. When Parks took charge, the surveying of public lands in Alaska had reached a stage where the work was more complex than it had been at the beginning of the direct system. By then it involved the survey of such things as townsites, isolated homesteads, National Park boundaries, forest reserve boundaries, naval and military reservations, and Indian allotments, as well as retracement of the boundaries of old surveys, examination of nonmineral surveys, and extension of the rectangular surveys.

In his first report to the supervisor of surveys, Parks speculated about the future:⁴⁴

It is almost impossible to estimate the cost of work during the coming year, but from the information available I believe we should have at least 40,000.00 allotted to Alaska. Much of our work will be scattered and transportation costs are high. If it becomes necessary to make additional surveys in the oil fields we would probably need more than that amount but I assume that we could be given an additional allotment of five or ten thousand if absolutely necessary.

One year later, Parks became governor of Alaska Territory. A new assistant supervisor of surveys for Alaska was not named. Martin George, office cadastral engineer, took over Parks' duties when Parks resigned. (In 1925 the offices of the surveyors general were abolished. In the ensuing reorganization, the chief clerks of the surveyors general's offices became office cadastral engineers and assistant supervisors became district cadastral engineers.) When Martin George died on December 27, 1925, Eckley C. Guerin was named engineer in charge of Alaska Surveys.⁴⁵ He held this position until Parks returned to the General Land Office as district cadastral engineer after his term as governor expired in 1933.

Matanuska Project

By then, the United States was in the depths of the Great Depression. The Roosevelt administration took steps to assist stricken farm families by establishing a Government-sponsored colony in the Matanuska Valley, northeast of Anchorage. Before the colonists arrived, the most desirable sections of the valley were surveyed into 40-acre tracts—200 of them.

The colonization of the Matanuska Valley was not an unqualified success; 40 acres proved to be too small a holding on which to make a living at that time, so many of the settlers gave up and left Alaska. The settlers who remained gradually enlarged their holdings, and Matanuska Valley farms were eventually numbered among the finest in Alaska.

George Parks retired from the Bureau of Land Management in 1948 after devoting some 40 years of his life to Government service in Alaska. In March of that year, as he contemplated retirement, Parks wrote:⁴⁶

Insofar as the Public Survey Office work is concerned there need be no apprehension. For more than a year Mr. Ross has been working with me on all phases of the work and he is familiar with the procedures and details in the

office and field. Mr. Berlin has had wide experience in the field and knows Alaska. These men have remained with the organization in Alaska notwithstanding other attractive offers of employment and it is my feeling that they have earned, and are entitled to, first consideration for advancement. In fact I do not know of anyone else who is qualified to carry on the work. . . .

Mt. McKinley National Park

The boundaries of Mt. McKinley National Park were run and marked by cadastral surveyors. The need for the surveys came about following information that 2 million acres, surrounding the highest mountain peak in North America, had been set aside as a National Park in 1917, by order of President Woodrow Wilson. The southern boundary of Mt. McKinley National Park was surveyed by a large party, including Leonard M. Berlin and Floyd Betts, during a summer season in about 1933. In 1936, the boundaries on the north and west had to be undertaken, but they presented quite a different challenge. The tundra, muskeg flats, and swift-flowing, unbridged rivers along those borders made winter ice a necessity for overland travel. No matter; to the men who had been on the earlier survey, the ice sounded infinitely preferable to the mosquitos.¹⁰⁷

The Men. Alaska survey veterans Berlin and Betts volunteered for the job. In choosing the rest of the party, veterans of prior North-country surveys, they sought men who were able to take care of both themselves and emergencies. There were no budget provisions for a cook, medic, or even a camp roustabout. The other men chosen were Ken Nelson, Larry Dauphiny, Herbert C. Torgerson, W. C. Conover, and Grant Pearson.

At that time, Floyd Betts was considered the "dean of Alaska surveyors." He had been surveying longer than any of the others.¹⁰⁷ Berlin gave him credit for teaching them more of the practical side of surveying in the Far North than they could ever have learned from books. Berlin put it all to good use later as a member of Admiral Byrd's 1939 expedition to Antarctica. Later still, Berlin became area cadastral engineer in Portland, Oregon, and state engineering officer in California.¹⁰⁴

Supplies and Equipment. All of the supplies and gear these seven men took with them had to be transported by dog sled. The concrete-filled iron posts that were used for markers on the survey weighed over three-quarters of a ton, which alone

limited the remainder of the supplies they were able to carry. Each man took one change of clothes, the best and warmest available. The snowshoes were also the best ones made, in spite of a limited mid-1930's budget, for obvious reasons. Food was another matter: they had planned that there would be plenty of game for meat, but in all the time they were out on the survey they did not see even one rabbit. Their dinner menus were therefore limited to beans, dehydrated potatoes, dried apples, rice pudding, coffee, cocoa, and baking powder biscuits.

The Work. The surveyors developed a system that worked fairly well for getting the work done, but it did not allow time for enjoying the spectacular views of the mountains, lakes, and Northern Lights. They had a 7-day work week, and were, by turns, scouts, solar observers, chainmen, and post-hole diggers.

That last-named duty was a rough one. Each post weighed 16 pounds, and each had to be buried 28 inches into the frozen ground. Of course the snow had to be cleared away before the ground could be reached, and this gave rise to the invention of altogether new invectives.

The men had to snowshoe across open spaces, set posts every mile, slash a 10-foot passage through tall trees when the line crossed timbered country, and pile up rock cairns nearly 6 feet high on all the high points of the barren areas. Thus the surveyors felt a justifiable pride when they looked back over their line and saw the miles they had marked through the icy land. To celebrate the distance covered, they put up a sign, "National Park Boundary." One of the men added another line, "If you've come this far, Brother, you may as well go on in."

On the last day of the survey Leonard Berlin was operating the instrument, with two men about a mile ahead of him, who had the only rifle in the party. Berlin could see them, but they were too far away to be of any help to him when he heard wild and threatening noises close to his position. Berlin had cut enough timber that season so that he felt pretty secure with a double-bitted ax in his hands. Soon four wolves lay dead at his feet. Because there was a bounty on wolves at that time, Berlin earned 80 depression dollars (almost a whole month's pay) from a few minutes with his ax.¹⁰⁷

Results. The surveyors completed the boundary work 5 days ahead of schedule, at the cost that had been estimated, and went on to Fairbanks. Once there, they rented rooms in a hotel and one of the

men announced, "I've rented this bathroom, I'm going to get my money's worth." The other men swore that he took seven baths that one day.

SURVEYS FOLLOWING STATEHOOD

Leonard Berlin was named regional cadastral engineer when George Parks retired. Shortly after that, Alaskans raised a forceful cry against their status as "second-class citizens." In 1956, with a view to impending statehood, the Kateel and Umiat Initial Points were established by designating USC&GS triangulation stations as initial points for the rectangular system. Thus, at least in theory, the entire State was covered by the rectangular system at about the time Alaska was admitted to the Union in 1959.

At the time of that historic event, however, less than 2 percent of Alaska had been surveyed. Under the terms of the legislation establishing Alaska as the 49th State, roughly 105 million acres of the Public Domain was to be turned over to Alaska. The land was in locations to be selected by the State of Alaska, and the BLM was directed to survey the boundaries of the State selections.

Because less than 3 million acres had been surveyed in the preceding 92 years, it was apparent that the immensity of such a surveying undertaking, coupled with the difficulty of the terrain, demanded surveying methods not contemplated in the 1947 Manual. Ultimate responsibility for developing and implementing such new methods fell upon Donald B. Clement, chief of cadastral surveys in Washington, D.C., and his successor, C. E. Remington, chief engineer, who was assisted by Clark L. Gumm, chief of cadastral surveys.¹⁶²

About this time, Berlin transferred to Oregon and Wendell G. Hall, a civil engineer and veteran second-generation cadastral surveyor, was transferred from New Mexico to Anchorage. It was Hall who developed the necessary office organizations to implement the new methods. In 1961, after Hall had developed the new techniques and procedures, D. R. W. "Rigger-Smith" replaced Hall.

The Hall System

With less than 2 percent of Alaska surveyed, it was usually many miles from any monumented corner of the rectangular system to almost any block of State-selected land. Therefore it was necessary to relate new surveys to the established rectangular system by means of related geodetic coordinates.

Under Hall's leadership, a system of protracted surveys, or plan of surveys, was developed for nearly all of Alaska's vast land and water area. The protracted surveys were all based upon existing coordinate systems. Protraction diagrams were prepared, each containing 16 townships, or a 24-mile "square," at a scale of about 2 inches per mile. The recomputed geographical coordinates for each township corner were shown on these diagrams. BLM field parties then extended the existing USC&GS triangulation net as the actual field surveys were executed. Since 1959, this system, which requires the processing of enormous amounts of data, has involved the use of electronic computers.¹⁶²

Photogrammetry

In order to place topography and culture on the protraction diagrams, the BLM contracted for aerial photography of areas to be surveyed. The BLM's photogrammetric branch in Anchorage had its own plotter and coordinatograph. Later it acquired its own airplane and aerial camera. By reversing this process, the lines of the rectangular system could be plotted directly on the aerial photographs, and the ground location of proposed State-selection boundary monuments could be chosen. Such monuments were not placed at all section corners, but only at intervals of about 2 miles along the township boundaries.

In order to set a monument by this method, field parties equipped with theodolites and electronic distance measuring equipment occupied intervisible points with known geodetic coordinates. By hand-held radios they talked a visible third field party to the point where the new monument was to be set, or as close to it as visibility would permit. Often in wooded areas where the monumentation party was obscured by trees much of the time, they would be talked onto a point as close as possible to the intended monument. The geodetic position of this alternate point would then be determined, and a traverse would be calculated and run to the point for the monument. Radio communication with the mathematics section in Anchorage was often used to facilitate such computations.¹⁶²

Photogrammetric support helped to make possible the execution of more than a million acres of State-selection surveys in the decade following statehood. It has also been extremely valuable in planning surveys of existing Native townsites and in the surveying of Alaska's myriad water boundaries.

Airborne Electronic Survey System

The chief difficulty encountered in using the new system was the frequent lack of a direct line of sight from the theodolite parties to the monumentation party, necessitating the calculation and running of the traverse. It was the classic surveyor's problem: the range pole just was not long enough. Jerry R. Harris, supervisor of theodolite field parties, who adapted the airborne control system to BLM surveys, helped improve the situation. He learned through some of his former associates with the Geological Survey that they had developed a device which they called the Hover Sight. This device enabled a helicopter pilot to see a spot on the ground directly beneath a flashing target on top of his hovering helicopter. At last the surveyor had a range pole that was high enough. The theodolite parties used radios to talk the flashing target to a point directly over the precomputed position for the monument. The pilot or his assistant then dropped an iron pipe monument draped with colored flagging directly onto the point to be monumented, or very close to it. Later a monumentation party set the monument, hoping that a playful bear had not carried it off before they got to it.¹⁶²

Meanwhile, in Fairbanks, Don Harding developed another variation of the theodolite-EDM method by using "smoke jumper" tactics. He and his men parachuted into wooded areas with power saws to clear heliports so theodolite crews could be landed.

The Hall/Wagner-Smith/Harding Period

The early years of surveys after statehood, which might properly be called the Hall/Wagner-Smith/Harding period, saw the development of the system that permitted the survey of some 1.5 million acres a year—acres that could not have been surveyed in 20 years at the same cost using conventional ground methods. Those early years were not without their anxious moments, however. Field parties who were inexperienced in the new methods were constantly exposed to all manner of hazards and discomforts, including bears and mosquitoes, downed aircraft, glaciers and icy raging rivers, sudden blizzards and earthquakes. Yet, even though there were a few close calls, not a man was lost nor a critical injury suffered.

Much of the risk arose from the field parties' almost complete dependence on aircraft to get

them into and out of the most remote and precarious locations. Great credit is due to John W. McCormick, chief pilot of the BLM fleet of aircraft, who kept the planes flying safely, and Brannon C. Casler, electronics engineer, who kept the field parties in constant communication with Anchorage and Fairbanks headquarters by a highly sophisticated radio network that covered much of the state.¹⁶²

SPECIAL SURVEYS

Cadastral surveys that involve unusual applications of, or departures from, the rectangular system are called special surveys. These surveys frequently carry out the provisions of particular legislative acts and include such work as small-tract surveys; townsite surveys; island and omitted land surveys; homesite, homestead, and trade and manufacturing site surveys; mineral segregation surveys; and various metes and bounds surveys.

Metes and bounds surveys are required to define the boundaries of irregular tracts that do not conform to legal subdivisions. Ordinarily this involves the establishment of the boundaries of claims, grants, or reservations, such as Indian reservations, small-holding claims, forest-entry claims, National Parks, and National Monuments.

Due to their very nature, certain types of special surveys occasionally involve a bit more adventure than might be expected during the course of some of the regulation surveys, as was true of the 1936 Mt. McKinley National Park boundary survey.

Prior to statehood there were vast areas of Alaska into which it was not feasible to extend the rectangular net. The coming of statehood did not alter the situation; this condition still prevails except for the protraction diagrams previously described. Yet the demand for official U.S. surveys of homestead entries (HES) or small claims has persisted. This has brought about the execution of great numbers of metes and bounds surveys not tied directly to the rectangular net. These Alaskan "special surveys" which include townsites as well as isolated settlement claims, are scattered from Ketchikan to Point Barrow and from the Canadian border to the western Aleutian Islands, and all of them are tied to natural features or previously set monuments. They are also tied to the rectangular system on diagrams and thus to the monuments of State selections.¹⁶²

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THE EARLY YEARS OF THE DIRECT SYSTEM

As authority and responsibility for retracements and resurveys expanded, the work of surveying the public lands became increasingly specialized. Rising land values helped make the public aware of the importance of the surveyor's work. A few people were even beginning to understand that one of their oldest and most fundamental rights—the right to own and inherit land—was dependent upon the work of the U.S. surveyors.

The pride and esprit de corps of the surveyors grew as the men became more experienced. All this combined to fire the imagination of many young men who clamored for places on the survey crews—boys who longed to savor the prestige and adventure of life in the survey camps. On June 3, 1914, Frank M. Johnson wrote a letter to C. L. DuBois, chief of the Division of Surveys of the General Land Office, in which he discussed the trials that accompanied the employment of these adventure-hungry youths from the East:³⁸

... I am rapidly reaching the conclusion that the fewer young men we secure from the East who have no conception of the work the better. I am receiving letters from mothers and fathers and sisters and aunts who seem to hold me personally responsible for every little incident in the surveying lives of their boys. The following incident is typical. A young man from the East was recently assigned to a surveying party in Montana on which there was working a teamster by the name of George and a mule by the name of Dynamite. One Sunday morning George endeavored to remove a cactus thorn from the instep of Dynamite's hind foot. After they had swept up George and reassembled him, he gave vent in the expressive and picturesque language of the plains to an opinion of mules in general and of Dynamite in particular. The young man from the East was horrified and of course immediately wrote home, describing the incident with, I suppose, such embellishments as would make good reading matter. I am now in receipt of a letter from his aunt intimating very strongly that I am personally responsible for George's vocabulary and for the weaknesses to which mule flesh is heir. This is just one case. There are many others. I think we can do better with Western boys who understand the customs of the country and the cussedness of mules.

TRANSITIONS

And other things were changing, too. Supplementary publications to assist the surveyors had been published, a new manual of surveying instruction was being prepared, and surveying instruments were being improved. Also, the traditional mode of field transportation—mules or horses and wagons—was giving way to more modern means of travel. The packer and teamster slowly began to disappear, along with the stagecoach driver and other colorful characters of the Old West.

Though they may have nostalgically mourned the passing of the old way, the surveyors were quick to perceive the advantages of such modern vehicles as trucks and motorcycles. In some areas, trucks proved their worth in the first few days of their use, but in remote and rugged places the old ways died hard. Remarked N. B. Sweitzer, "The crews all more than like the new trucks. However, occasionally one heaves a sigh for one of the old favorite mules, who, like Gunga Din, had many friends among the crews."³⁹

SOME OF THE MEN

John S. Knowles

John S. Knowles, who was to later serve as office engineer of Montana and Colorado, as well as area cadastral engineer for Area 3, went to work on a Colorado survey crew in 1912 when he was 16 years old.

In those days, physical ability and the ability to get along with both men and mules counted almost as much as technical proficiency. Knowles himself has said, "In those days if the field engineer let you off on Sunday, you thought he had gone soft." At the beginning of his long and distinguished career, Knowles, as one of the younger surveyors, was assigned the field completion of several jobs in the rugged Elk and San Juan Mountains in Colorado. On those jobs all iron posts, groceries, and feed for the mules were packed in by mule. After camp was set up, the mules could rest; the equipment for each day's work was packed by the men.

Once, in complaining about the lack of corners to an old contract surveyor who had done original

DEPARTMENT OF THE INTERIOR
GENERAL LAND OFFICE
Office of Assistant Supervisor of Surveys
250 Federal Building, Phoenix, Arizona

May 6, 1919

Mr. Frank M. Johnson
Supervisor of Surveys
Denver, Colorado

Dear Sir:

In view of your description of the 1st., Mr. Francis F. Joy, U.S. Cadastral Engineer, would be a very welcome addition indeed to the field forces in California, but my smile faded when I came to the last paragraph of your letter wherein it is proposed to exchange for Mr. Joy, Mr. Arthur W. Brown, U.S. Cadastral Engineer. I am glad you are giving me the opportunity to voice my views on the subject, which are as follows:

(1) Since Mr. Brown came to California, many times have I thought with satisfaction of the healthy atmosphere he has created among the surveyors in that state. As you know, he has plenty of jazz and the way he has hopped over the pinnacles and double timed across the deserts has kept the other surveyors up on their toes in an attempt to snap into it as quickly as Brown. . . . California needed new, young blood. It got it. Naturally I am loath to lose it.

(2) While it is true that the number of resurveys in California is insignificant compared to Colorado resurveys, yet California has its complicated resurveys and Brown is the only surveyor I have who has the knowledge, judgment and experience to bring them to a successful conclusion. . . . I need one good, bang-up resurveyor and Brown is one.

(3) I understand that Mr. Brown has made extensive family arrangements in California. Of course he is the sort who would go anywhere he is sent without complaint, but if I am not mistaken a move to Colorado would cause him considerable annoyance and expense.

(4) I have always had the feeling, possibly a mistaken one, that Brown belonged to me. As you remember, he started out on our surveys as my axeman and later became the most satisfactory chainman I ever had. I know him and his ways intimately. He knows me and my ideas. It is a source of great satisfaction to me to have him in my district.

If the reasons for his transfer to Colorado outweigh those given above, I shall be reconciled to the change.

Very respectfully,

A. C. Horton
Asst. Supervisor of Surveys

* * *

The reply to this was a telegram from Frank M. Johnson dated May 9, 1919:⁴⁷

"Joy will be transferred to California. Brown may also remain there. Send district eight surveyors north at earliest possible date or whole Oregon and Washington program will fail."

surveys in the area, Knowles told the surveyor (who was "about 94 years old at the time") that they could find almost no evidence of some of the corners. The old surveyor sympathized, telling Knowles that sometimes it was difficult to find those corners two days after they had been set. They had used wood stakes at that time, and the Indians often removed them to use for firewood in that treeless prairie land. Resurveying in that area, Knowles found, meant that the surveyors had to look for "any physical evidence we could find—buried charcoal, axe marks, a stack of buffalo horns, mounded sod—anything the original surveyors might have used to mark or witness their corners."¹⁵²

Glenn R. Haste

Glenn R. Haste began his Government service in 1913 as a cornerman with a cadastral surveying crew in New Mexico. He later became area engineering officer at Denver, a position he still held at the time of his retirement in 1961. During the intervening years he gained a reputation for speed and quantity of work, as well as for excellence in the performance of his duties. As early as 1919, Alonzo Compton, then assistant supervisor of surveys in New Mexico, wrote of him: "In my opinion Mr. Haste is a valuable man to hold in the surveys, and will soon rise to the top as an engineer. Incidentally Mr. Haste was the principal assistant who chained 21 miles of township exteriors in one day."¹⁴⁸

Dupree R. (Herk) Averill

Another surveyor who started his career about the same time as Haste and Knowles was Dupree R. (Herk) Averill. He was born shortly before 1900, and started surveying in about 1914.

One of his early survey assignments was in a then-remote part of the Kofa Mountains in Arizona. Averill was flagman, and he decided to give the instrument man a point he could not occupy with the instrument. He found his opportunity when a tall chimneylike pinnacle fell on the line. Somehow he climbed it. The instrument man refused to play Averill's game and simply ran an offset line around the pinnacle.¹⁶⁴ It was at that point that Averill found that he could not get off the pinnacle. The obscure hand- and footholds he had used climbing up were not visible as he looked downward. The survey party left him there overnight to teach him a lesson.

Dupree R. (for Reed) Averill's name might not be recognized by his peers or surveyors who came

after him, because he was always called "Herk."⁷⁹ It was the name given to him by men who were trying to unload some water barrels from the bed of a rig they were using on their survey. When it became evident that they had no idea how to do the job, Averill snorted in disgust and said that he would show them how to unload a water barrel.

There is a trick to dealing with something of that sort. Men on the survey crews learned to let the weight and motion of such objects work for them. Averill just quickly tipped the barrel up on its rim and, as its momentum helped him, he used his knee for leverage and lowered the 400-pound barrel to the ground. From that time on, he was known as "Herk" because of the men's admiration of his "Herculean" strength.¹⁸⁴

The Harringtons

Guy P. and Earl G. Harrington were both with the General Land Office and the Bureau of Land Management for many years. Guy P. Harrington was appointed assistant supervisor of surveys for New Mexico on March 17, 1922, upon the resignation of Alonzo E. Compton.

In 1908, when he was about 18 years old, Earl G. Harrington, Guy's younger brother, became a field assistant on a General Land Office survey party in Minnesota, his home State. It was the beginning of a long career in cadastral surveying.

In 1928-29, Earl G. Harrington, then a cadastral engineer, resurveyed a part of the Michigan-Wisconsin line, under the direction of commissioners representing the two States. The line he reestablished was originally surveyed by William Austin Burt in 1847.³² Earl Harrington located the stumps of two of the original bearing trees and a small circular mound of stone about 6 inches below the ground surface. These marked the western end of Burt's line. The east end of the line was reestablished from what Harrington believed to be the first bearing tree Burt had marked on this line. Burt's name, the date, and the initial mile number were found incised on the tree.

Harrington found nearly three-quarters of the original mile and half-mile corners. In a few places, stone monuments were found. In most cases where one of Burt's corners was found, the location of at least one of the original bearing trees enabled Harrington to find the corner. Sometimes the outer chip removed from an old bearing tree showed the mirror-image of the markings as plainly as the original markings appeared on the tree itself.

Harrington reported that the line surveyed by William Austin Burt varied only slightly from its

intended bearings and distances. He credited it with being one of the best of the early surveys.³⁰

Earl G. Harrington was cadastral engineering staff officer of the Bureau of Land Management when he retired in 1959. His career in cadastral surveying had lasted for more than 50 years. Following his retirement, he remained interested in surveying and served as consultant for the Louisiana Land and Exploration Company. He died in June 1966.

Donald B. Clement

Donald B. Clement became cadastral survey staff officer of the Bureau of Land Management following Earl Harrington's retirement. At the time he accepted this position he had been involved in cadastral surveying for almost 50 years.

Clement, like the Harringtons, was from Minnesota. On August 20, 1910, he joined a survey party in eastern Montana. He was about 18 years old, and his job was digging holes and planting corner posts. In 1914, Clement went to Washington, D.C., and, with the exception of 2 years with the Iowa State Highway Commission, he worked there the rest of his life.

In later years, Donald Clement earned a reputation as an expert in solving riparian rights problems. Clement retired from the Bureau of Land Management in the early 1960's and died in late November 1965.

Andy Nelson

Minnesota was the State where still another long-time cadastral surveyor got his start. His name was Andrew Nelson. He was first employed in the survey of the public lands in 1904, when he was 16 years old. Young Andy Nelson was assigned to work with an examiner checking surveys near the Minnesota-Canada boundary that first winter. He and the examiner worked through temperatures of 50° below zero. They traveled by canoe or snowshoes, and the main part of their diet was moose meat.

Nelson was given a temporary appointment in 1910, when the contract system was discarded in favor of the system that allowed the General Land Office to form its own group of competent surveyors. In 1917, after taking a Civil Service examination, Andy Nelson accepted a permanent appointment as a cadastral engineer. His career took him to a dozen States and over some of the wildest, most rugged terrain on the globe, including the deeply carved, perpendicular scenery of Bryce and Zion Canyons.¹¹⁰

Andy Nelson liked to tell of his survey of the southern part of the Salt Lake Meridian. It had been run south from Salt Lake City to a mountainous area, but not all the way to the Utah-Arizona boundary. Nelson was given the task of establishing the southern end of the meridian so that surveys could begin in the southern part of the State. He and another surveyor spent several days making longitude observations, and completed their task. In later years, both ends of the Salt Lake Meridian were finally joined. The two ends missed an exact connection by less than a quarter of a mile, which is still considered quite accurate for longitude.¹⁵¹

During the course of a 1926 survey, Andy Nelson looked through his transit and saw a part of a wagon wheel. That barely visible wheel led him to what was left of three wagons that had been abandoned by the unfortunate Donner party as they crossed the Great Salt Lake Desert in 1846. On this same survey, Andy Nelson found more evidence of preservation in this desert. Nelson had to tie his survey to one done nearly 30 years earlier, and it turned out to be so easy he could scarcely believe it. He found the tracks of the previous survey party still clearly marked in the salt. He literally followed the footsteps to the corner he sought.¹¹⁰

For more than 50 years, Andy Nelson was a cadastral surveyor. He often told people that he enjoyed his rugged life. Perhaps that is why, even when he was past the age of 70, he remained as strong and lean as a whip.¹⁵⁸ After he retired, he returned to the BLM to execute some special surveys in Utah. Until shortly before his death in the middle 1960's, Nelson's step still had a spring to it, and his hair was without a streak of gray.

While he was still an active surveyor, Andy Nelson became almost a legend. It was said that he had surveyed more miles than any other cadastral surveyor. It was also said that he made it a practice to supervise the marking of each corner on his surveys. Men who have retraced his lines have found they could depend upon the accuracy of surveys done by Andy Nelson.¹⁵⁸

Roger F. Wilson

Roger F. Wilson, California's most prolific surveyor, retired in 1963 with a record that put him in the same league with Andy Nelson. At his retirement, Wilson was given a "diploma," which indicated that he had signed his name under 36,000 miles of various types of surveys during his career as a cadastral surveyor—10 to 40 miles each week

for 6 months or more each year for more than 42 years add up to many miles.

A bad ear had kept Roger Wilson out of World War I, and at the beginning of 1919, he had, in his own words, "a cushy job that netted more than 300 [dollars] a month . . . and no worries." Then one day, an old high school friend, Johnny Knowles, came by. Johnny was home from the war and bursting with excitement. He had passed the Civil Service examination for U.S. transitman before he went away, and now, at last, he was preparing to leave with his first field party.¹⁶³

John Knowles must have made cadastral surveying sound like the good life, because on May 13, 1919, Roger Wilson—whose background in surveying consisted of a good foundation in mathematics and a genuine liking for trigonometry—boarded a train with Hans Voigt and was off to the canyon of the Grand River. Wilson's pay consisted of plenty of fresh air and \$60 a month, though he did work "the way up to \$75 a month that season. His first assignment was as notekeeper (rear chainman) for John Knowles.

That summer, Roger Wilson's education in the survey of the public lands began. He credits Hans Voigt with being one of the best instructors the GLO ever had. Hans Voigt arranged his instructions so that the men had to become involved with the problems. This was accomplished so smoothly that they did not even realize until later that they were being taught. For example, Roger Wilson said that he was required to get up at 3 a.m. to take an observation on Polaris, at elongation, to "check" the hour angle Hans Voigt had taken at a more convenient twilight hour. He learned to keep notes by being sent out with an experienced drag chainman, to rechain a mile of line that "didn't close," and to write down the topography as it was called off to him. From the following day, Roger Wilson was on his own, having learned exactly what Hans Voigt planned for him to learn. Soon John Knowles had Wilson preparing the daily solar declination chart and course and distance diagrams. He learned to close his own sections within half the allowable limits and also to close elevations within 50 feet using vertical angles and distances—a far from easy matter.

On November 13, 1919, Wilson returned to Denver, but was back with the survey party again in May 1920, when they finished the work begun the year before in the beautiful but rugged Colorado Rockies. By that time, John Knowles had Roger Wilson "checking his transit all day Sundays on the camp meridian and reading the 'Bible' [the Manual of Instructions] in . . . [his] spare time."

On February 9, 1921, Wilson took the Civil Service examination for U.S. transitman and the next day he was on a train headed for another job. Joe Davis had a survey party in the northwestern corner of Arizona, and he needed a notekeeper. Wilson spent 3 months there, and for that 3 months work he received \$225, which was about what his train fare and expenses had cost him. He was back in Denver in time to go to southeastern Colorado with John Knowles early in June. That area is prairie land, and they timed themselves once at $\frac{1}{2}$ mile in 9 minutes. They dragged the tape out all 5 chains and gave it a flip. The rear chainman held 5.00 next to the pin on the ground, and the front chainman stuck the pin at 0.00. When he had used his 8th pin, they got lined in for the corner point. John Knowles kept up with the chainmen in a Model T converted flatbed truck.

Wilson went back to Denver in December. He had passed the examination and accepted a temporary appointment in California. He left for California on February 13, 1922. The train dropped him at Goff, which is situated some miles west of Needles, California, and "some miles in any direction from any place else fit to be inhabited." He was picked up by the truck driver and they drove for miles along dirt tracks to the survey camp.

After several assignments in California, Wilson had his own field parties except for a part of 3 or 4 years in the 1920's when he worked with Carl Seibecker and with Herk Averill. Tom Winkler was one of his principal field assistants for some 25 years, which was about the length of time J. D. Dukes served as the cook for Wilson's survey crews.

For most of his long career, Wilson surveyed in California, Nevada, and Arizona. In the mid-1930's, however, he was assigned to a job near Spartanburg, South Carolina. Some of the lines that he resurveyed there were property lines that had been originally surveyed by George Washington.¹⁶³

Roger Wilson always took pride in the surveys he executed. He advised the men on his survey crews to pretend, as he did, that the land they were surveying was worth a thousand dollars a foot instead of the less than nothing it sometimes appeared to be. It was a good guess, because some of those surveys are used to describe oil-producing lands now valued at very nearly that amount.

WORLD WAR I

The effect of World War I on the surveying service was well described in a letter Frank M.

Johnson received from N. B. Sweitzer, assistant supervisor of surveys in Omaha. It stated, in part:⁵⁰

... to thoroughly understand the conditions involved as regards the resurveys, I beg to state that at the declaration of war practically the entire field and office force in the Third Surveying District volunteered. All that remains of as an efficient an organization as the General Land Office ever had are some who could not get into the army.

And, of course, some of the surveyors who went off to the Great War did not come back. . . .

NEW MANUAL

In 1918, the work was resumed on the new manual of surveying instructions that had been in process of preparation for some time. Chapters I

through V treating Regulations Imposed by Law, Instruments and Methods, System of Rectangular Surveys, Corner Monuments, and Restoration of Lost and Obliterated Corners, respectively, were finished and had received the formal approval of the board overseeing the project. Chapter VI, which dealt with the complex and farreaching subject of resurveys, was being revised because of the difficulty encountered in treating such an important and intricate subject in a comprehensive manner in the space allotted for it. Chapter VII on Special Surveys and Instructions, chapter VIII on Field Notes, and chapter IX on Plats were all being written.⁵⁸

One of the minor changes in chapter VIII showed a definite trend toward modernization. Originally, field notes were transcribed by hand in ink but beginning in 1894, either handwritten or

EPISODE AT THE MEXICAN BORDER—1916

Although by 1916, Frank M. Johnson was well pleased with the way the surveys were progressing, occasionally there were incidents that affected them adversely. And sometimes those things had no relationship whatever to the surveys themselves. For example, in March 1916, Pancho Villa raided a small American army town in New Mexico.⁶⁴

Mexico's leader, Carranza, agreed to allow American troops to pursue Villa into Mexico, but apparently he had not envisioned General John J. Pershing's 7,000-man army, which plunged some 300 miles into Mexican territory. The Mexican people felt they had been invaded and demanded that the troops be pulled back. Meanwhile, many Americans insisted that only a military invasion could bring peace to the strife-torn border country.

While this was taking place, a survey under Group No. 36, California, was under way, a fact that involved Wilford Utterback and his crew in "an unpleasant and provoking difficulty with the Mexican Customs Officials at Tecate, Mexico. . . ." Apparently, on May 20, 1916, Utterback, who was busy with computations and paper work, sent three of his assistants "to make search for and destroy the old corners set by Deputy Surveyor S. W. Brunt, along the International Boundary in 1878."

Assistants Adams, Valentine, and Webb drove a team to the boundary line. There they found the road had been washed to a deep rut on the north side of the fence defining the northern boundary of the 60-foot-wide neutral strip on the American side of the boundary line. The surveying assistants did not want to block the road, so they drove through the fence and pulled the wagon off the road to allow the passage of other teams. They then went off to work.

The three men finished their assigned task and returned to the wagon at 6 p.m. They were immediately "accosted by three armed Mexican border guards." The guards ordered the men to measure the distance from the fence to the team. They did so and discovered that the forefeet of the mules were on Mexican territory.

At gun point, Adams, Webb, and Valentine were forced to pick up their transit and other equipment and accompany the guards to Tecate, Mexico, where they were placed in custody by Mexican soldiers.

By 8 p.m., when the survey party had not returned to camp, Utterback grew uneasy and rode to the boundary. He found the place where the men had planned to leave the team and discovered that they had driven south into Mexico.

Utterback (along with a Campo, California, U.S. customs officer named Osborne and a U.S. immigration inspector named Webb) drove to Tecate, Mexico, where they, with the help of an interpreter, were able to effect the release of the men. However, they were not able to get the team and equipment back without a hearing.

Problems between the local customs officers and the officer in charge of the soldiers at Tecate caused some delay, but late Monday evening a message came from Governor Cantu of Mexicali, Mexico, suggesting a three-man commission be taken to the scene of the arrest. If conditions were found to be as represented by Utterback, Cantu directed the mules and other confiscated property would be released.

Utterback telephoned to Campo for an automobile. When it arrived, he and the officials selected by Governor Cantu started for the border. When they reached the place, they found that conditions were as Utterback had described them. They went back to Tecate where the mules, wagon, and other equipment were cleared by the customs officer. Utterback gathered up the confiscated property and was back at his survey camp by noon on May 24. The following day he wrote a report of the incident to A. C. Horton, Jr., assistant supervisor of surveys for District No. 5 (California and Arizona). It included the following statement of expenses incurred:

DEPARTMENT OF THE INTERIOR
GENERAL LAND OFFICE

STATEMENT OF EXPENSES INCURRED IN LIBERATING TEAM AND MEN APPREHENDED BY MEXICAN OFFICERS
ON THE INTERNATIONAL BOUNDARY LINE, MAY 20, 1916.

May 23, feed two mules May 21 and 22, at 50¢ per head	\$2.00
May 23, board and lodging self and assistants at Tecate, Cal. store, May 21, 22, and 23, and incidental expenses	6.70
May 24, room and breakfast at J. Thing's residence	1.00
feed mules overnight	.50
May 24, hire of automobile to drive Mexican Commissioners from Tecate, Mexico to scene of arrest	10.00
May 20a, hire of automobile to haul me to Tecate, Mexico, from Campo May 20	
May 21b, hire of automobile to transport assistants from Tecate, California to Campo	
(Items a and b not yet settled but will be about \$15.00)	
May 22, telegram sent by Immigration Inspector Webb to Governor Cantu at Mexicali explaining arrest of party, and asking immediate release	1.10
(The above made at my request, as Mr. Webb has personal acquaintance with Governor Cantu.)	

(Vol. 90—Report from Willford Utterback to A. C. Horton, May 25, 1916)

typewritten field notes were acceptable. Following a 1910 directive (confirmed by the "Manual of Surveying Instructions, 1930"), all final field notes have been typewritten on regulation field note paper.³⁷

The original plan for this sixth manual of surveying instructions had called for only nine chapters, but a tenth, dealing the Mineral Surveys, was eventually added.

DIRECTING THE CADASTRAL SURVEY

In 1919, Clay Tallman, then commissioner of the GLO, inquired about the high cost of surveys in Washington State. Frank Johnson, who had recently returned from a visit to the Northwest, replied in part:⁵²

... the cost of field work anywhere is regulated largely and often entirely by physical characteristics of the country under survey [topography and vegetation], weather conditions and location with respect to supply stations. This is particularly true of surveys in Washington where we are surveying the State exchange lands. These lands lie along the watersheds of the Cascades and Olympic Mountains in some of the roughest and

brushiest and wettest country in the United States or Alaska, and are so remotely situated with respect to the beaten paths of travel and the bases of supplies that it is often necessary for the entire surveying crew to cut and build trails before they can manpack their outfits to the field of operation. The almost daily rains and fogs, the trail cutting, and the natural difficulties of progress on the line on account of the roughness of the surface and the density of the vegetation, when it is possible to work on the line, bring up the cost of the work to a high figure if we measure it on a mileage basis . . . but I believe it is commensurate with the work in hand. *It could not have been done at all under the old system.*

As the surveys progressed, it became clear that Frank Johnson could be stern. He could and did give orders in a blunt, no-nonsense manner if he had to, as indicated by the following letter:⁵³

June 23, 1920

Dear Mr. Kidder:

I have your telegram this morning quoting telegram from [name], U.S. transitman, in which he says "Transfer to Denver office not accepted without

increased compensation one fifty [\$150] month including bonus unless office work very limited."

I have sent the following telegram to [the transitman]:

"Referring your telegram to Kidder comply immediately with official orders issued you. Further instructions will be given you from time to time as the situation warrants and as the good of the service might dictate."

As you know I have little patience with men in this service who threaten to quit unless certain concessions are granted them. Such men may quit and unless they are very careful they will be asked to quit; nor am I given to debating the question of assignment or salary with surveyors and transitmen.

Mr. [—] can either comply with these orders and take his chances of promotion along with the rest of the men, or he can send in his resignation.

It is probable that after assisting Mr. Brown for awhile on some office work here, I shall send him to the field.

Very Sincerely,

Frank M. Johnson
Supervisor of Surveys

Johnson could also follow orders—as was necessary when his forwardlooking, innovative methods were not entirely appreciated by his superiors:⁶⁶

October 27, 1925

Mr. Frank M. Johnson,
Supervisor of Surveys
Denver, Colorado.

Sirs:

You are hereby directed to discontinue at once the use of the radio as a communication service. Hereafter, whenever a more expeditious means of communication than is afforded by the mails is necessary, the telegraph will be used exclusively.

Very respectfully,

William Spry
Commissioner

USGS TAKEOVER ATTEMPT

Beginning with the passage of the first land ordinance in 1785, surveyors were required to note mines, salt springs, salt licks, mill sites, water courses, mountains, and other remarkable and permanent things over and near which their lines passed, as well as the quality of the land. From time to time, surveyors general issued instructions that

enlarged the list of items the surveyors were to note.

Because of the fact that the surveyor usually was the first scientific-minded observer in each new area, it was considered natural that he should cover several fields. By the mid-1800's, full-scale geological surveys were being made in Iowa and Wisconsin in conjunction with the public land surveys. In fact, most agencies concerned with Federal public lands trace their beginnings, at least in part, to the General Land Office. During the early years of the GLO, deputy surveyors were expected to deal with things far beyond the normal concept of their duties for a simple reason—for the most part, the surveyors were the only ones there. For nearly a hundred years, no agency other than the GLO was much concerned with the public lands.

Following its creation in 1879, the U.S. Geological Survey made several attempts to take over the rectangular surveys. All of these moves were unsuccessful, including the major campaign launched in 1920 to have the cadastral surveys placed under the topographic branch of the Geological Survey. Successful resistance to this move was probably due to Frank Johnson's wide acquaintance with Western Senators and Congressmen, his own excellent reputation, his past experience, and his ability to communicate his well-founded objections to the proposal.

At the start of his career, Johnson had worked on a combined cadastral and topographic survey project on the lands of the Cherokee, Choctaw, Chickasaw, Seminole, and Creek Indians in Indian Country (Oklahoma). He had first-hand knowledge of the difficulties brought about by the differences in purpose behind topographic and cadastral surveys. While Johnson agreed that it might be theoretically expedient to consolidate similar surveys under one agency, he also pointed out that *there is no similarity between topographic surveys and cadastral surveys*. Topographic surveys are made for informative purposes; cadastral surveys are based upon, interwoven with, and regulated by the law; they thus permit the fundamental national land policy of managing and disposing of the public lands under proper guarantee of title to be carried out.

Scientific surveys made for informative purposes can be changed as more information is made available, as conditions change, or as better equipment becomes available. By way of contrast, cadastral surveys mark the lines and corners of the public lands according to specific law, and *for all time*.

SURVEYORS GENERAL UNDER THE DIRECT SYSTEM

For many years, a surveyor general was a political appointee for each state and territory on which public land surveys were being executed. They then made contracts with deputy surveyors for the surveys in their respective districts. This general scheme was still in effect when Congress abolished the contract system in 1910, and deputy surveyors ceased to exist as such. However, the offices of the surveyors general, which were a basic part of the contract system, were not abolished at the same time. This made the surveyors general something of an anachronism; their offices were organized to handle a situation that no longer existed.

The surveyors general still had considerable political influence, even though their powers were greatly reduced. Because their offices still existed, they were utilized as well as possible under the new system—a circumstance that created an unwieldy division of duties that was neither satisfactory nor economically sound.

The work of surveying the public lands is a single process completed in a series of related steps. Technical instructions are issued and the surveys are executed in the field, including the preparation of the records thereof. Then the field notes are transcribed for the permanent record and the official plats are prepared. After that, there is a technical review prior to acceptance of the survey.

During the first 15 years of the direct system of surveys, the U.S. surveyors were detailed to whatever area in which surveys had to be made. They worked under assistant supervisors who were directly responsible to Frank M. Johnson. Johnson was directly responsible to the commissioner of the General Land Office. The Special Instructions for the surveys were, however, issued by the surveyors general. And in 11 Western States and Alaska, the work of transcribing the field notes and the preparation of the official plats was done by transcribers and draftsmen under the various surveyors general. Because of this, there was no real standardization in the making of official plats. Each office engaged in constructing official plats of surveys complied with the general technical requirements on base plats, but each relied mainly on its own conception of artistic value in showing topography and cultural features.

The surveyors general also handled the disbursing of funds for their own offices, and, after the beginning of the direct system, for the field as well, except in Alaska. The surveyors general were not

accountants, however, so financial clerks were hired to do the work.⁶²

The returns of surveys were sent to Washington for final examination prior to their acceptance by the commissioner. Thus the surveys were executed by the surveying service, approved by the surveyors general, and accepted by the commissioner.

The retention of the offices of the surveyors general, along with the awkward division of surveying responsibility, was recognized as a costly carry-over from the contract system. Nevertheless, it continued until Congress, by the Act of March 3, 1925, abolished the offices of the surveyors general. Two of the offices which had existed under the surveyors general since 1800—those of register and receiver—were consolidated, and all references to "receiver" were dropped. Under the terms of this act, all references to surveyors general were changed to "supervisor of surveys."

The news that the supervisor of surveys was to take over the administrative duties of the surveyors general was widely approved. In early April 1925, Frank M. Johnson received a letter that apparently expressed not only the writer's view, but also that of many other people. It stated, in part:⁶⁷

The abolition of the offices of Surveyors General, while a foregone conclusion, carried with it the problem of subsequent administration, and your selection for this duty was an exceedingly happy solution. Indeed, I doubt very much whether the Supervisor of Surveys would have been the legislative successor of the Surveyors General if he had not been Frank M. Johnson.

THE CONSOLIDATED SURVEYING SERVICE

As soon as the abolition of the offices of surveyors general was announced, Frank M. Johnson began to set in motion a plan to streamline the consolidated surveying service. Frank L. Lewis became chief clerk and senior accountant and auditor,⁶⁸ and the titles of the following assistant supervisors of surveys were changed to district cadastral engineer: Guy P. Harrington, J. Scott Harrison, Albert C. Horton, Jr., Herman Jaeckel, George D. D. Kirkpatrick, Ernest P. Rands, Nelson B. Sweitzer, and John P. Walker.

The titles of the following chief clerks of offices of surveyors general were changed to office cadastral engineer: Martin George, John D. Adams, James M. Wasson, Alan R. McCord, Ralph

W. Nelson, Norman L. King, John W. Rowland, George F. Nader, and Joel Q. Naret.

Thomas F. Mathias, chief draftsman of the office of surveyor general at Helena, Montana, was also named office cadastral engineer, as was S. W. Goodale, acting chief clerk in the Salt Lake City office of the surveyor general. George A. Parks resigned his position as assistant supervisor of surveys and public lands for Alaska when he became Governor of the Territory on June 15, 1925. Martin George, in his capacity as office cadastral engineer, was authorized to perform the routine duties that had been performed by Parks. At the time there were only three cadastral engineers in Alaska—all experienced men—so it was not deemed necessary to replace Parks at that time.⁶⁶

Johnson found that there had been a proliferation of the title of "draftsman" within the offices of the surveyors general. Transcribers of field notes, accountants, clerk-stenographers, and even messengers had been given that designation. Yet, "Whyte of the Denver office is listed as a copyist-draftsman, but actually makes and has made for many years the most difficult of plats, those of resurveys." Others with no particular distinction in the kind of work they were doing were called "clerk-draftsmen," "topographic draftsmen," and "draftsmen." Johnson recommended that, in the interest of proper administration, everyone be given proper titles.⁶⁶

Russell K. Allen

Russell K. Allen, former chief clerk in the office of the surveyor general in Denver, was appointed as "administrative cadastral engineer." Highly esteemed by Johnson, Allen was widely recognized

as one of the best informed men on cadastral surveys and cadastral survey procedures in the GLO, or, for that matter, in the private sector. For a number of years he edited, and in effect approved, every set of Special Instructions issued by the supervisor of surveys.¹⁵⁹

Until his retirement, virtually every controversial survey or resurvey problem resolved in the GLO was reviewed by "R.K.A." Over the years, those initials on a regulation or decision became a hallmark of technical excellence, giving to such documents unquestioned authority. Allen's knowledge of mineral surveys and the problems related to them qualified him as an expert in the field. He was, in large measure, responsible for the basic content of chapter X of the 1930 and 1947 Manuals, as well as for a great many other decisive directives that form the body of the mineral survey and resurvey procedure that is still in use.¹⁵⁹

Nebraska Office Abolished

During the years immediately following the consolidation of the surveying service, the need for surveys in Nebraska gradually declined and there was talk of abolishing the surveying office there. Frank M. Johnson opposed the move because he considered N. B. Sweitzer's experience on both surveys and resurveys too valuable to lose. Nevertheless, in 1929 the office was consolidated with the Denver office under the direction of Herman Jaeckel. Although this news must have been a blow to Sweitzer, it was nothing compared to the crash of the stock market with which it almost coincided. N. B. Sweitzer retired in December 1929, and the United States plunged headlong into the Great Depression of the 1930's.



Quintin Campbell, U.S. transitman, in Oregon, 1917. The instrument is a Buff transit.



Survey of the 9th Standard Parallel North, T. 37 N., R. 2 E., Gila and Salt River Meridian, Arizona, November 1925. William E. Hiester, U.S. surveyor, at the transit.



A. C. Horton, assistant supervisor of surveys, on left, and his packer are shown catching up on their reading. The camp is under the bamboos during the Indio Desert survey investigations. The photograph was taken during the winter of 1915-16. The place was T. 5 S., R. 6 E., San Bernardino Meridian, California.

Unidentified cadastral surveyor in camp adjusting what appears to be a Young and Son transit. Photo probably prior to 1920.





A camp in southern Idaho, fall 1919. The men in the photo are not identified.



Blackfoot Indian Reservation on Milk River, Montana, 1922. Divide Peak in Glacier National Park forms the background for the camp of surveyors Roy Bandy, Ernest Parker, and D. W. Eaton.



Humphrey Mountain on the east boundary of Yellowstone Park, 1931. The men at the top of the peak are building a corner. There is another corner on the rock under Roy Bandy's transit.



July 1940, survey of islands in the vicinity of Point Lobos, California. The surveyor, Eimer D. Calvin, is using a pipe as a walkway.



Typical Nevada desert survey, 1949. The instrument is a Gurley transit.



Survey of the north boundary of Yellowstone National Park, at the head of Pebble Creek. The corner is on the top of the peak; the photo was taken in the early 1930's.



Roy Bandy's crew, 1931. Left to right: Roy Bandy, Tingley, Jack Morris, Ariel Barney, Don Thompson, Marvin Thompson, and Frank Montblier. The men are carrying survey equipment, blankets, food, tools, and corner posts. Their destination, 2,000 feet up to the top of the ridge at the foot of Cody Peak, is too rough for pack mules.



Two surveyors, at the top of the photo, view the place where the survey line crosses the Gunnison River in Colorado. The river is 2,500 feet below them. Group No. 333, 1940.



United States cadastral survey office, Helena, Montana, April 14, 1930. Seated left to right: Guy H. Richardson; A. T. (Alex) Harris; J. Scott Harrison, assistant supervisor of surveys; George F. Rigby; H. B. or A. H. Hibbard, mineral draftsman. Standing left to right: Ernest Parker, Ranney Y. Lyman; Phillip Inch; Claude F. Warner; W. R. (Roy) Bandy; Fred L. Cumming; Dan P. Mumbrue; George F. Tyrrell, draftsman; Melvin J. Davis, chief clerk; H. J. (Jim) Goodall, office engineer; Minerva Thomas, clerk.

William B. Kimmel in camp in Wyoming; year unknown. He is holding a young wildcat.



Anthony (A.C.) Kimmell was called "Tony." It is believed that this photograph was taken in Arkansas, but the year is unknown.



A. N. Kimmell and party on the roof of the Federal Building in Anniston, Alabama, May 1918. Left to right: unidentified, Hal D. Craig, Frank Constantine, unidentified, A. N. Kimmell, Thomas E. Hiester, Jim Quigley (?), and Arthur C. Buttrick.



Near Cimarron, Colorado. The year is not known, but the man on the left in the wagon is Everett H. Kimmell. A. N. Kimmell, fifth from left in the above photo, was Everett's father. William B. Kimmel and A. C. Kimmell were Everett's uncles. Keith K. Kimmell (not pictured) was his cousin.



Chainman Sam Roberts took this picture of Roy Bandy (lower right-hand corner) in 1937 during a survey (retracement) of the Montana-Wyoming boundary line. The boundary line runs east and west through the boulder-filled canyon in front of the surveyors.



A mountain stream for General Land Office surveyors Guy R. Veal (with steel tape) and Hugh Crawford (at transit) to contend with.

175



Looking for a pack trail route to the isolated eastern part of Yellowstone National Park in 1932. Left to right: Ariel Barney, Roy Bandy, and Ed Wilson.



Shown descending Notch Mountain on the eastern boundary of Yellowstone Park in 1932 are Jack Morris (above) and Oliver Tingley (below).



*Guy P. Harrington, GLO district
cadastral engineer, March 1941.*



*Near the base of Mt. McKinley in 1906. The crew is pictured
resting on its trek back to the railroad after completion of its
assignment. Both men and dogs were used to backpack all
the equipment used.*



Roy Bandy and some of his trophies, circa 1940. Note model 70, 30-06 Winchester rifle and Weaver scope on antlers.



A cook tent in some rugged country—a spike camp, section 14, T. 37 N., R. 109 W., Sixth Principal Meridian, Wyoming, 1935. Pictured are Arnold Bigler and friend.



Wyoming, 1935. Left to right: Lester Stoll, Charles Hansen, Dave Todd, Dick Simmers, Bill Anderson, Leo Peterson (party chief and later, area cadastral engineer, Area 2), Willis Brown, Elmer Lenhart, and Victor Stalick.



Roy Bandy's pack train moving along the eastern boundary of Yellowstone National Park at the top of the Absaroka Range, 1932.



Pack train halts for packer to check the loads. The survey party is moving along the eastern boundary of Yellowstone National Park in 1932.



In camp during the 1936 survey of Mt. McKinley National Park boundary, in Alaska. Left to right: Herbert C. Torgerson, Leonard M. Berlin, Kenneth M. Nelson, and Grant Pearson.



Herman Jaeckel, district cadastral engineer, in his office at the U.S. Customs House, Denver, Colorado, April 7, 1941.



Leonard M. Berlin setting up a transit north of Sitka, Alaska, in the spring of 1947. His attire is not that of a surveyor working in the field; Berlin was just about to make a trip into town.



Elliott Pearson at camp at Gila Bend, Arizona, 1947. The instrument is a Hellgate model Gurley transit.



A two-man mosquito tent in camp near Campbell Creek, south of Anchorage, Alaska, 1950.



Dupree R. Averill at Cuyama Valley, California, during the winter of 1948-49.



A. C. (Tony) Kimmell in May 1938. The camp is in the desert south of Wamsutter, Wyoming.



Emil Voigt in his 1949 survey camp at Porter Springs west of the Seven Troughs Mountains in Nevada.



Group No. 312, Survey camp near Pikes Peak, T. 15 S., R. 68 W., Sixth Principal Meridian, Colorado, 1938. Thomas W. Crawford's party.

August 26, 1948, on the Utah-Wyoming State line near mile post 37. The survey party is under the direction of F. Wayne Forrest. The man in the foreground (kneeling) is stamping the section number into the brass cap of a survey monument.



Surveyor C. Albert White on rocky pinnacle in the Seven Troughs Mountains, west of Lovelock, Nevada, circa 1948.



*Herk Averill in the southwestern
part of Arizona during the winter
survey season of 1946-47.*



*Thomas W. Crawford.
Year and place not known.*

*A 1/4-section corner in T. 29 N., R. 27 E.,
Mt. Diablo Meridian, west of the Seven
Troughs Mountains in Nevada. There
are thousands of similar corners in the
United States.*



*Andrew Nelson, shown sighting through a
Gurley transit.*



August 26, 1948. F. Wayne Forrest at a Buff solar transit. The two young men with Forrest are Robert C. Mountjoy and James M. Smith. The iron post under the transit is the $\frac{1}{4}$ -section corner between sections 19 and 30, T. 18 N., R. 120 W., Sixth Principal Meridian, near the Colorado-Wyoming boundary. It was established in 1909.



P. T. Reilly shown scribing a bearing tree in the San Bernardino Mountains, 1937.



A dividend of working in the wilds—fresh fish for dinner. This photo shows two members of Ted VanderMeer's party in Covelo, California, Eel River, 1937.



A survey party including Roger Wilson and P. T. Reilly shown setting a temp in the Borrego Valley in 1938.



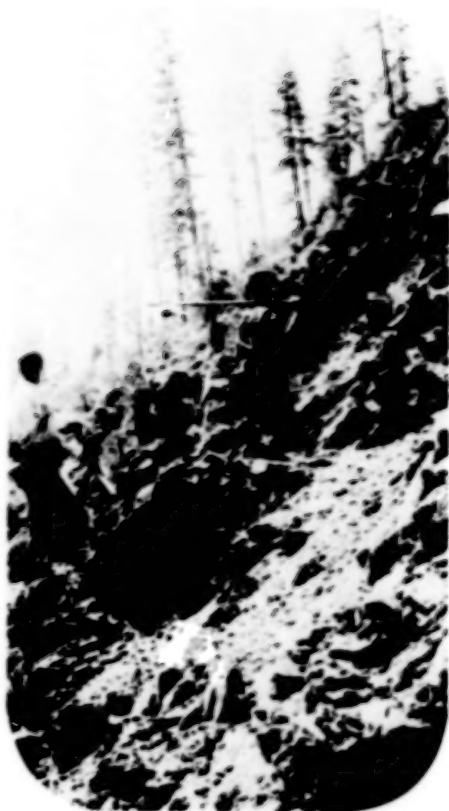
Pictured discussing their plans are, from left to right, Ty White, P. T. Reilly, and Elmer Vick. They are at T. 3 S., R. 2 E., San Bernardino Meridian, in March 1937.



"It's dry enough to hold us," Roger Wilson predicted before their truck became stuck in a wash after a cloudburst. The men are in the Borrego Valley in April 1938.



P. T. Reilly throwing a poke stick (dooley stick) at Mt. Pass, California in 1939.



At the North Fork of the Feather River in 1940, P. T. Reilly is shown at work, directing the flagman. Roger Wilson was the party chief.



Tom Tillman, in the summer of 1952, at camp on the North Fork of the Smith River, Willamette Meridian, Oregon.



Hobart B. Hyatt's survey camp near Anchorage, Alaska, adopted "Sissie," a pet bear. The time is August 1950.



Modern-day (1960) surveying methods: Jerry Harris on a tellurometer station on a point above Minto Flats, Alaska.



Helicopters aid the surveying of Alaska. Shown is Don Harding, chief of cadastral surveys for the Fairbanks District, in 1960.



Frank M. Johnson, named as the first supervisor of surveys in 1910, a position he held until his death in 1944.



Clark L. Gumm (on the left) and Lyle Jones (on the right), attending a conference in Alaska in 1969.



Joseph Thoma was pictured on the cover of Gurley Bulletin 112—T (Gurley Telescopic Solar Transit). Another photo, taken at the same time, showed both Thoma (on the left) and Arthur D. Kidder (on the right).



William Teller, long time second-generation cadastral surveyor. At the time of his retirement (1976), Teller was chief, Cadastral Surveys, Denver Service Center.



Emil Voigt and Marion Clawson in Nevada, 1949. Clawson was BLM director from March 1948 until April 1953.

MODERNIZATION OF THE SYSTEM

THE DEPRESSION YEARS

The cadastral survey program was expanded to help promote employment during the dark depression days. At that time the GLO had a huge backlog of jobs and many public land lines were surveyed and marked by the men who found work under this employment program. Cadastral engineers, surveyors, and transitmen were regular Civil Service employees. Others who had cadastral survey experience were granted temporary appointments, but many of the young men on the field crews were there by virtue of the sponsorship of some U.S. Senator or Representative.

Under the expanded survey program, Guy P. Harrington, district cadastral engineer at Santa Fe, divided New Mexico into two areas. Fred L. Cumming, Ernest Parker, Claude (Hefty) Warner, Roy Romberg, and Roy Bandy were sent to the west area to run survey parties during the 1933-34 winter. Glenn R. Haste, who had begun surveying when he was still in his teens, was put in charge of the east area. Roy Bandy was the man in charge of the west area. The survey projects included regular cadastral surveys as well as the boundaries of National Forest Reserves and National Monuments.

In 1936, P. T. Reilly was one of the young men who found employment in California under the expanded cadastral survey program. During the time he was with the GLO (4 years), he worked on several different surveys and with several different surveyors. In 1940, as it was becoming obvious that the war in Europe was worsening, Reilly left the GLO to work in the aircraft industry.¹⁵⁶

One of the men Reilly worked under was Ted VanderMeer ("Van"). He had begun his career in 1913 as an axeman on a survey party in northern Idaho. The attraction of a job that took him "to a new place every day and a new residence every week or so" was too good to pass up. Van was to work with such men as Ray D. Armstrong, I. W. Stoddard, Al Kimmell, Theodore O. Johnston, H. Raymond, Phil Inch, and Herk Averill. Van received his appointment as a U.S. transitman during the 1920's and retired from the BLM in 1952.¹⁶¹

Arthur Brown was another surveyor of the day who taught young men like P. T. Reilly their vocation. He became a U.S. transitman in 1913 and was a U.S. surveyor by 1915. Brown was highly rated by both his superiors and the men on his

survey crews. He retired in the mid-1950's, but returned to the BLM to work on difficult and controversial surveys in the area of the Great Salt Lake.

SURVEYING FAMILIES

Down through the years there has been the repeated incidence of boys who admired older members of their families who were surveyors so much that they followed them in their vocation. Everett Kimmell and his cousin Keith were among those who followed such a family tradition. Everett's father, A. N. Kimmell, was a surveyor, as were his brothers Anthony C. Kimmell and William B. Kimmell. Records show that the original spelling of the name was Kimmel. The addition of the final "l" was an innovation not adopted by William B. Kimmell,¹⁵⁹ a circumstance that proved to be confusing to those employed on surveys by various members of the family because all three brothers worked in Idaho.

Ernest Parker did much surveying in Montana. His brother, Horace, worked mainly in Utah. Kansas-born Tom and Hugh Crawford were also brothers. At one time, Hugh drove a stagecoach that carried mail in Colorado.¹⁵⁹ He later invented an aluminum scribe for marking trees. The Crawford brothers surveyed in several Western States, and Hugh also worked in various Eastern States for about 15 years. Tom Crawford became the office engineer in Montana in the early 1950's.

Wendell V. Hall was born in Indiana and entered the surveying service in 1912 as a temporary transitman. He received his appointment as a U.S. surveyor one month later. For many years he worked in New Mexico. His son, Wendell G. Hall, was born in 1906, and signed on in 1932 with the GLO as a cadastral surveyor. He spent his entire career with the GLO and its successor agency, the Bureau of Land Management. His skill and professional integrity were unquestioned. Wendell G. Hall was responsible for the surveys in the new State of Alaska during the 1950's. In recognition of his accomplishments, he received both the bronze and silver medals for meritorious service from the Department of the Interior. Wendell Hall died in Santa Fe in 1974.

Lewellyn D., Ranny Y., and Edward O. Lyman were brothers and all three were surveyors. Edward O. Lyman was born in 1883 in Dakota Territory; his older brothers were both born in Ohio. Charles M.

Pidgeon was born in late 1862 in Clarke County, Virginia; his surveyor son was C. Chandlee Pidgeon. Fred and Frank S. Spofford were brothers. Fred's first surveying job was as second assistant with his brother when Frank was an examiner of surveys.

Brothers Van and Ty White worked in Arizona about 1910. Ty also worked in California. Later, Wendell G. Hall and Ty White both worked in the Dakotas as did William Teller, son of Addison R. Teller who was an examiner of surveys along with Frank M. Johnson. Bill Teller was just a boy when he first worked on his father's survey crew. Later, his knowledge and years of experience, along with his amazing memory with regard to public land surveying matters, made him a popular speaker. Teller was named chief of cadastral surveys in the Denver Service Center in 1965. He still held that position at the time of his recent retirement. Teller was actively involved in public land surveying for nearly half a century.

The Saxons were a family surveying team, as were William Hiester and his younger brother, Tom, who worked mainly in southern Utah and Arizona. Hans Voigt and his younger brother, Emil, were of German extraction. They both were surveyors for many years. Emil worked for several years in Nevada, while Hans surveyed mainly in Colorado. Two more pairs of surveyor brothers were Fred L. and James R. Cumming and Lester L. and Donald B. Clement. Richard E. (Elmer), W. R. (Roy), and Willis W. Bandy were all born in Missouri. Elmer was born on Lincoln's birthday, 1880; Roy, exactly 5 years later; and Willis, in August 1890.

Elmer taught school in Routt County, Colorado, for a couple of years, and in April of 1904, he joined the public land survey crews of Colonel Samuel W. Brunt and his son Arthur H. Brunt. Arthur was a well-known engineer and surveyor, and both of the Brunts were, at that time, contract surveyors for the General Land Office in the Big Horn Basin of northwestern Wyoming.

Colonel Brunt was a gray-bearded veteran who had held survey contracts in California as early as 1879.¹³⁶ Colonel Brunt asked Elmer if he had any brothers back in Missouri that they could use, so, in June 1905 Roy Bandy joined the Brunt survey party at Garland, Wyoming.¹⁴⁵

One of Roy Bandy's first public land survey jobs was as chainman on Arthur Brunt's contract for the survey of part of the Twelfth Standard Parallel North in Wyoming. The line ran westward from a point 15 miles north of Worland, Wyoming, across

a rough 60 miles to Carter Mountain, west of Meeteetse. The first 40 miles of the survey line were through desolate, arid, rock-covered badland country.¹²⁰

Early in July, the nine-man crew left Cody, Wyoming. Their two wagons were loaded with surveying equipment, tents, beds, and cooking equipment. The men rode atop the loaded wagons. They traveled in this manner for about a hundred miles, until they reached a log house on the west side of the Big Horn River. That log house was Worland, Wyoming.

Breakfast was at 6 a.m. and supper was at 6 p.m.—which meant a 12-hour work day. The men hiked to and from the work area. They carried their lunch in a handkerchief or a piece of flagging tied to their belts. The quart canteen of water they packed with them had to last all day.

The survey line was run with a solar compass or a solar transit. A one-chain steel tape was used, and the tape was leveled. (The modern clinometer had not yet been invented.) The chainmen kept track of the distance by the time-honored method of counting the tally pins, one pin for every chain. If the ground slope was steep and it was necessary to take less than a chain, a mark was made, and the pin stuck in the ground when the full hundred links were reached.

The chainmen, in this instance, Arthur Brunt and Roy Bandy, took turns going ahead with the chain. They changed every ten chains. The same man always started out from a corner and went ten chains. The front chainman had ten pins, and when the last of them was stuck into the ground, he would call out, "Tally one." The rear chainman then walked up counting his pins. If the count was ten pins, he would say, "Tally one, ten pins." In this manner it was known immediately if either one had lost a pin. If one was missing, they went back, also in the time-honored manner, and chained it over, in order to be sure of the distance. The rear chainman took the lead for the second ten chains. One man always had all the even-numbered tallies and the other man had all the odd-numbered tallies.

On this survey, where they were running a straight line all the way, camp was moved about every 2 days. For 2 months they surveyed the line and set stone corners. At the end of the 60 miles, they went on to another job—that of subdividing a township on the east slope of Carter Mountain. During that entire 4-month survey season they saw only one town—Meeteetse, Wyoming—which, in 1905 consisted of one general store and three saloons.¹²⁰

In 1906 Alpheus P. Hanson, surveyor general of Wyoming, appointed Roy Bandy a U.S. deputy surveyor. Bandy and Arthur Brunt were awarded a contract for the survey of six townships in the Big Horn Basin, so Roy Bandy, at the age of 21, became the youngest deputy surveyor to hold a contract that year. That contract was completed the following summer.

Elmer Bandy surveyed with the Brunts until shortly before the beginning of the direct system. Frank M. Johnson hired him in 1910 and assigned him to work under J. Scott Harrison, assistant supervisor of surveys for Montana. He stayed with the GLO and surveyed in Montana, California, and Arizona until he grew ill in late 1915. He died two months later, on January 15, 1916.⁵⁶

Wilford Utterback and Roy Bandy, who had both run survey crews for the Brunts, were employed in 1911 as cadastral surveyors working out of the Cheyenne, Wyoming, office. Charles M. Pidgeon and his son, C. Chandlee Pidgeon, and Mark Kelly, Herman Jaeckel, Homer and Wesley C. Saxon, and Hans and Emil Voigt also worked out of the Wyoming office at that time.¹⁴⁵

In 1914, Roy Bandy was transferred to Helena, Montana, under J. Scott Harrison. One of his first assignments was to work with Guy R. Veal and Glenn Sawyer on the survey of the breaks along the Missouri River. The Missouri River Breaks, south of the Bear Paw and Little Rocky Mountains, is an area of spectacularly fractured land. It is badlands country with strange, abrupt upward thrusts of sandstone, and canyons that plunge downward for hundreds of feet. It is a rugged, tortured land, and the few scrub pine and cedar trees that try to grow there are gnarled and twisted like the rest of the landscape.

While Roy surveyed in Montana, Willis Bandy also worked on the public land surveys. He was a field assistant several summers and went on to become a surveyor. Willis Bandy was promoted to the position of party chief in the 1920's, and, from all accounts, he was a good one. At about this time, Glenn Sawyer, Ernest Parker, David Eaton, A. Parker Warner, Phillip Inch, and Charley Seeley all ran survey crews under Roy Bandy on the survey of the Crow Indian Reservation.

In 1928, J. Scott Harrison characterized Roy Bandy as "the finest executive I have in the service."⁶⁹

Roy Bandy completed a law degree while he was a working cadastral surveyor. It must have been difficult, but he knew it would give him a better understanding of land laws, and he hoped that would make him a better surveyor. After 4 long

years and much dedication, he received his degree in law. Bandy put in many hard years of work with the Bureau of Land Management, and finally retired in the mid 1950's.

EL DORADO SPRINGS

Before the Hiesters, Kimmells, Crawfords, and other families of surveyors had all retired, another name began to appear on the roster of cadastral surveyors. It was not a family name, but a town, and it occurred so often that people began to wonder about it—El Dorado Springs, Missouri. Roy Bandy finally explained what made this small Missouri town so well known in cadastral surveying circles.

It began with Eddie Wilson, who had worked on Bandy's survey party for a time. Eventually, Wilson went back to Missouri, and settled down in El Dorado Springs. Because his wife was related to Bandy's wife he and Bandy kept in touch. Once, when Bandy needed some new recruits for his survey party, he let Ed Wilson know about it. Wilson, who was well acquainted with the people in his area, knew Bandy believed that bright, hard-working farm boys sometimes made the best surveyors. Wilson talked to some of the young men, and one of them joined Bandy's survey party. Over a period of time, Wilson encouraged several young men to become cadastral surveyors, and a number of them are still with the Bureau of Land Management.¹⁴⁵

YELLOWSTONE PARK BOUNDARY

In 1931 Frank M. Johnson asked J. Scott Harrison to assign Roy Bandy to the survey of the revised east and north boundaries of Yellowstone National Park. The revision of the boundary lines changed them from straight lines that crossed mountains and drainages to lines following the divides that separated the watersheds. The new east boundary was high atop the divide between the waters flowing into the Yellowstone system and those flowing into the Shoshone River.

The change in boundary was made to ease the work of the rangers employed by the National Park and National Forest Services. It did not, however, ease the work of the men sent to survey the new lines. The surveyors had to run a broken line along the crest of the mountain ranges, keeping always to the sinuosities of the divide. This meant that the surveyors were required to climb the highest peaks and set corners on them.

It took three summers to complete the survey that established this park boundary. The surveyors climbed upward to the top of 11,360-foot Eagle

Peak, the highest point in the park, before their job was finished.¹⁴⁵

MISSOURI RIVER BASIN PROJECT

During the next few years as Congressional appropriations for cadastral surveys were shrinking, the need for resurveys within the areas administered by the Bureau of Reclamation was growing. Roy Bandy was convinced that the cadastral surveyors employed by the GLO were the people who were best trained and equipped to do the work. In 1939, he talked about this to Fred Munro, who was a project engineer for the Bureau of Reclamation. Munro took the idea to his superiors, and funds were allotted for a survey needed in connection with a plan for the resettlement of homesteaders on the Yellowstone River.¹⁴⁵ That survey was the start of the vast reimbursable cadastral resurvey project in the Missouri River Basin.

At the beginning of 1946, A. C. Horton, then supervisor of surveys, and Herman Jaeckel, the assistant supervisor of surveys for Montana, Wyoming, and Colorado, visited the Helena office. They announced that the Bureau of Reclamation had requested that all the cadastral surveys in the Missouri River Basin States be executed by the GLO. This area included Montana, North Dakota, South Dakota, Wyoming, Colorado, Nebraska, Kansas, Missouri, and Iowa.

Roy Bandy was directed to take charge of the immense project. He was to make preparations to begin the surveys in April, so he obtained authorization from Horton to call up as many experienced cadastral surveyors as he needed. Funds were made available to him for the purchase of the vehicles and equipment that would be needed. On schedule, in April 1946, Roy Bandy opened an office in Fort Peck, on the Missouri River in Montana. George F. Rigby, who had been recalled from retirement, was his helper. Glenn R. Haste, acting as Bandy's assistant, opened an office in Flaxton, North Dakota.

In one month there were 18 survey parties in the field. The party chiefs were all experienced cadastral surveyors: R. Y. Lyman, Ernest Parker, Andy Nelson, Arthur Brown, Lloyd Toland, Emil Voigt, Russell McDonald, Willis Bandy, Tom Crawford, Hugh Crawford, John S. Knowles, Leo Peterson, Lyle F. Jones, William Teller, Wendell G. Hall, Ty White, Quintin (Jerry) Campbell, and Claude (Hefty) Warner.¹⁴⁵

Wendell Hall and his survey party were stationed at Crosby, North Dakota. Ty White's crew executed

surveys at Mellette, South Dakota. Later in the summer, they surveyed in the area near McIntosh. Lloyd Toland's survey party was working in the same area along the Grand River. Both crews were working on the survey for the Shady Hills Flood Control project.

CAMP COOKS

Cooks in the survey camps were often interesting types. One cook was called "Whispering Willie." He had been a fighter and his vocal cords had been damaged in the ring.¹⁴⁶ Another, Gus Ritter, was characterized as "an ornery old goat who could destroy a case of beer (24 cans) in one night by opening one can after another from his cot."¹⁴⁶ Sometimes the wife of the party chief became camp cook, but this was rarely more than a temporary occurrence. Generally, camp cooks were men who understood their importance in the scheme of things and were proud of their line of work. Some of them were friendly and some grouchy, some were clean, and some were careless. The menu often depended, to some extent, on the cook's background. If the cook, whatever his origins or interests, understood that men who work hard in the open care little for fancy food but have a great need for good, wholesome, and nutritious food, the crew could count itself a lucky one. Many culinary sins could be forgiven if a hot cup of coffee was always on hand and there was an occasional piece of pie to go with it.

Keeping fresh meats, milk, and vegetables on hand was difficult in some areas, so some ingenious methods were devised to handle the problem. One fairly common sort of cooler consisted of three or four frames about 20 inches square with screen bottoms, and wet gunny sacks hung from the sides. These were hung one above the other by knotted ropes at the corners, and the unit was then suspended from a tree. If there was no tree, the cooler could be placed on a stand in whatever shade was available. Frequently, in the old days that was the shade afforded by the wagon or the tents. Later, trucks provided the shade. These evaporative coolers worked well, especially in the desert.

Camp cooks also had to deal with stoves that were not the sort found in the average kitchen. The Kimmel camp stove was a favorite. William Kimmel invented it. A particularly good feature of the stove was that it could be telescoped for packing. Being both sturdy and portable, it met most of the requirements for camp cooking.

A New Idea in Camp Stoves

INVENTED BY WM. B. KIMMEL

U. S. SURVEYOR

a man who has spent his life in survey camps, and knows the hardships and discomforts of the ordinary sheet steel camp stove.

This stove is the result of years of study to overcome many of the inconveniences and discomforts of camp fire—poor cooking, burned bread, cold food, chopping small wood, stoves burning up and fires going out.

PROBLEM SOLVED AT LAST

SEVENTEEN REASONS WHY THIS STOVE IS THE BEST

1. You can bake bread with a red hot fire while doing your other cooking. **This is impossible** with any other sheet steel camp stove made.
2. This is the only **sheet steel camp stove** made upon which it is possible to prepare a complete hot meal. With other stoves you have hot bread and a cold meal or a hot meal and cold bread. **Oven top is used for a warming closet.**
3. Our No. 1 stove has the largest oven of any **sheet steel** camp stove in use. Oven is 18 inches deep, 22 inches wide, 7 $\frac{3}{4}$ inches high.
4. Oven protected by **asbestos board and dead air space, reinforced with steel**, making oven ever-lasting and prevents burning of bread and meats while baking.
5. Fire box will last for years. No backs or bottoms to burn out—**no lids to lose. Don't have lids.**
6. Our No. 1 stove has extra large firebox made of heavy steel, size of fire box 13x18x28 inches with 9x13 inch feed door. Top has channel steel strips on under side to prevent sagging from heat and weight.

7. No more chopping of wood into small or short pieces. You can burn logs or sage brush—thus eliminating half of the drudgery of camp life.

8. This stove will hold fire over night, as it is absolutely air tight.

9. You can take this stove down or set it up in one minute on any kind of ground. No tools required.

10. You can cook for six to fifteen men on our regular No. 1 stove, which has three times the capacity in cooking surface of any other **sheet steel** camp stove made.

11. Three joints of pipe packed in the oven; the legs fold and are held firmly in place; the oven telescopes inside of extra heavy fire box, making a package of our No. 1 13x18x28 inches and weighing 50 pounds. Made of heavy steel.

12. This stove is exceptionally handy to pack and carry on pack animal. It can be used for side pack in regular alforjas.

13. **A LEG BRACE**—In connection with the folding leg we have attached a folding leg brace which securely locks the leg. Stove absolutely rigid now when set up. Held in place, set up or knocked down, by same fastener.

14. **DETACHABLE COLLARS**—Collar on the firebox and oven are now removable and packed in oven. These collars simply drive into place and securely held there.

15. Not necessary to crate stove in shipping; the package is smooth on all sides. This saves ten pounds in weight on the crate, and a big advantage in packing on pack animal.

16. On all door fasteners we are now using large steel key rings. Besides folding out of the way, they give the user a secure hold in operating the handles.

17. We have also quit using draft slide in the feed doors, for the reason that all doors burn out first at this point in every camp stove. As our firebox sets on the ground (see cut) all that is required for draft is to dig a small hole under edge of firebox; the size of the opening regulates the draft (simple solution). By covering this opening completely the stove is made airtight and will hold fire for forty-eight hours or more. Tops of fireboxes and ovens are now reinforced with Channel Iron to prevent sagging from heat and weight of utensils.

In using stove to prolong its life **do not build a bon-fire in fire box**, because it is large. Make a small fire and place green-back logs if possible on each side. This protects the firebox.

**IN ADDITION TO OUR NO. 1 LARGE SIZE TELE-
SCOPE CAMP STOVE WE ARE NOW MAKING
A NO 2 SMALL SIZE. INTENDED FOR
SMALL CAMPING PARTIES OF
TWO TO FOUR MEN.**

Size of firebox No. 2 stove, 23½x13 inches by 12½ inches high, which is also the outside measurements when telescoped. Oven 12½ inches deep by 17½ inches wide and 7 inches high. Weight 35 pounds, made of No. 24 gauge steel.

All oven doors have new oven door supports with patent clips that do not bind.

**OUR STOVES ARE ESPECIALLY ADAPTED FOR SUR-
VEYORS, FOREST SERVICE MEN, SHEEP MEN,
PROSPECTORS, CAMPERS, HOMESTEAD-
ERS, MINERS AND AUTOMO-
BILE TOURISTS.**

This stove has been used extensively all over the west for the last four years by Forest Service men and U. S. Surveyors.

The following letter speaks for itself (received last year):

Department of the Interior,

General Land Office,

Office of Assistant Supervisor of Surveys.

Boise, Idaho, March 25-14.

Telescope Camp Stove Co., Boise, Idaho.

Gentlemen:—

Please quote me prices of 25 of your new improved Kimmel Pat. Camp Stoves No. 1, Large Size, as per Sample submitted, to be delivered at our warehouse. I believe with your new method of protecting the oven with extra sheet steel and ½-inch dead air space, together with asbestos board, that you have now the most Ideal Oven ever put in a camp stove.

We have been using your Kimmel Camp Stove in Colorado, New Mexico and Montana for 4 years and consider them the best Camp Stove made. My department has purchased about 50 during this time. Yours truly,

FRANK S. SPOFFORD,

Assistant Supervisor of Surveys.

PRICES F. O. B. BOISE

No. 1—Large size, 13" x18"x28". wt. 50 lbs. - \$10.00

No. 2—Small size, 12½"x13"x23½". wt. 35 lbs. - 8.00

Telescope Camp Stove Company

1505 NORTH TWELFTH ST., BOISE, IDAHO

THE FOUR CORNERS

The State boundaries of most States west of the Mississippi River, plus a number of the central and southern States, were surveyed under the direction of the General Land Office. Many resurveys or retracements of parts of these State boundary lines have been made in the course of the regular cadastral surveys of the public lands. Sometimes, several surveyors, over a period of years, had a part in establishing or marking these boundaries. One such case, albeit an unusual one, began with the survey of the southern boundary of Colorado from the southeast corner of the State westward to the 103rd Meridian. It was surveyed by Macomb, in 1858-59. The same portion of the south boundary of Colorado was resurveyed by John G. Major, a deputy surveyor.

The New Mexico-Colorado boundary from the 103rd Meridian westward was surveyed by United States Surveyor E. N. Darling. He was instructed to survey along the 37th parallel, but later, investigation showed gross errors in the line in the area near Edith, Colorado.

In 1902-3, H. B. Carpenter resurveyed the entire line dividing the State of Colorado from the Territories of New Mexico and Oklahoma. His line differed from Darling's and resulted in a boundary dispute. The United States Supreme Court, in an opinion dated January 26, 1925, stated that Darling's line was the correct one in spite of its errors and regardless of the temporary General Land Office use of Carpenter's line. The Carpenter line was not used after that time for public land surveys. In 1917, the portion of Darling's line between mileposts 202 and 241 had been rerun by W. C. Perkins of the General Land Office. Perkins' line was monumented with iron posts, and it was accepted by the court.

The court appointed Arthur Kidder as commissioner to resurvey Darling's line. The field work was done under his supervision, but the execution of the survey was slow, due to delays in the receipt of funds from the States involved. After Kidder's death in 1958, Joseph C. Thoma was appointed as the new commissioner. It was he who prepared the final report that was approved by the Supreme Court on October 24, 1960.

Monuments set in 1859 by Macomb and in 1900 by Levi S. Preston in a resurvey of Major's line $2\frac{1}{2}$ miles eastward to the northeast corner of New Mexico were to be the controlling points in the survey, according to instructions of the court.

Kidder's survey began at the Macomb monument, which he replaced with a concrete post

bearing a bronze tablet. The line then ran east to the Preston monument; then west, reestablishing Darling's survey. This resurvey was controlled by the monuments established by Darling that were recovered. Bronze-tableted concrete mileposts were set on the line between the original mileposts. Perkins' iron posts were reset in concrete in their original positions. The Carpenter monuments that were known to have been used as points of reference for local surveys were preserved, but the boundary marker identification was removed from them. All the other Carpenter monuments were destroyed.

The closing point on the west end of the line was a point set by Deputy Surveyor C. Robbins as he surveyed the Arizona-New Mexico line in 1875. This line is on a meridian determined by reference to a landmark peak called "The Needles" by the Wheeler survey of 1874. Robbins called it "the southwest needle point of Wilson's Peak." The boundary line was run west and north to the point where the 32nd Meridian west of Washington intersects the south boundary of Colorado. The point established by Robbins was 1 mile 45 chains east of the mark that had been established by Darling, in 1868, as the southwest corner of Colorado. Robbins' point was accepted, and thus became the only monument in the United States marking the common corner of four States—Utah, Colorado, New Mexico, and Arizona. From this point the west boundary of Colorado was surveyed in 1879. The Utah-Arizona boundary, which intersected Robbins' point, was run in 1901.

In 1899, the original sandstone marker was found damaged. It was replaced that year by Page and Lutz. In 1931, Everett H. Kimmell replaced the Page and Lutz stone with the present concrete monument. Subsequently, the Department of the Interior placed a 28-foot-square concrete paving block around the monument in 1962. It is oriented in the cardinal directions, with the names and seals of four States appearing in their correct quadrants.³⁵

WORLD WAR II

Frank M. Johnson was still supervisor of surveys when the bombing of Pearl Harbor plunged the United States into World War II. By then he had served under six administrations (Taft was President when the direct system was inaugurated). He guided the surveying service through several major crises including World War I, the 1929 stock market crash, and the Great Depression that followed it. But Johnson did not live to see the end of World War II. He died on March 27, 1944. Johnson was 71

years old and had been employed by the Department of the Interior for nearly 49 years. For more than 33 of those years he had been the head of the cadastral surveying service.

Johnson had always been a forward-looking man—one who was very aware of the fact that change is one of the few certainties of life. Although his half century of service saw much of the Public Domain transferred to private citizens or to business or non-Federal Governmental organizations under various land laws, it was also an era characterized in large measure by programs aimed toward the ultimate conservation of the

Public Domain. This was true in spite of the long-held public attitude that management of the public lands was a temporary measure, to be used only until the lands could be transferred to other ownership or assigned to special use reservations as they had been in the past.

About the time of Johnson's death, this attitude began to undergo a profound change. The value of administering some of the Public Domain for multiple uses and reserving it for future generations began to gain recognition. The era of the transfer of the public lands, with its emphasis on private interests, was definitely on the wane.

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NEWS, NOTES, AND ANECDOTES

LAND SERVICE BULLETIN

Beginning in 1917 and continuing into the 1930's, a monthly "Land Service Bulletin" was printed by the General Land Office. Composed of news notes from all the offices, the Bulletin was edited by Judge S. V. Proudfoot of the GLO. News about the surveying service was gathered from the assistant supervisors by Frank M. Johnson, who selected items and prepared them for the Bulletin. During its first few years, the Bulletin was filled with interesting happenings and personalities, but later the administration issued an edict stating that the Bulletin should be more formal in tone. Thus, for its remaining years, the Bulletin contained material not unlike that which now appears in the "Federal Register."

The following item appeared in the August 1917 Bulletin:³⁶

The newly appointed transitmen in the Field Surveying Service were assigned to the field as follows: Thomas Walter Bates, Willis J. Millrick, Barney M. Pellum and Courtenay Q. Wheeler, District No. 7; Roy T. Campbell, J. Pierce Dunn, Herman F. Mader and Chester W. Pecore, District No. 8; Glenn R. Haste, District No. 4; Marvin J. Lytle, District No. 2; Charles F. Moore, District No. 1; and Andrew Nelson, District No. 6.

Barney Pellum was lucky to make that list. Two years earlier, he had been chainman on Wilford Utterback's crew (Group No. 61, Idaho) and had slept outside the tent one warm September evening. At about 1 a.m. he was attacked by a rabid coyote and bitten on the forehead. Fortunately, the party chief got Pellum to Boise where he received the Pasteur treatment for rabies, and thus survived.⁴⁰

RED RIVER

Meander of Red River in Oklahoma

The General Land Office will undertake next summer the remeandering of the north bank of Red River in Oklahoma west of the 98th meridian in order to admit of the proper disposition of lands in the former Kiowa and Comanche Reservations which border on the river. The boundary lines of lots formed by the subdivisional surveys of 40 years ago have been materially changed by erosion, and in some cases purchasers of land from the Government have not been able to find any land remaining.³⁴

A Boundary Survey

The discovery of oil in the Red River Valley in Texas caused land prices to skyrocket. Suddenly, the location of the state boundary became vitally important. The Oklahoma-Texas line along the Red River was at one time a part of the boundary between the United States and Spanish holdings in the Southwest. Any rights to the bed or to the banks of the river were dependent upon the wording of the Treaty of 1819. One hundred years after the treaty was signed, Oklahoma brought suit against Texas, and the United States intervened to protect the rights of the Kiowa and Comanche Indians. The amount in question was in excess of \$100 million.

As a result of these suits, Supreme Court proceedings fill more than 5,000 pages in nine separate volumes. More than 5 years passed before the case was settled, and more than 400 witnesses were questioned about the 539-mile-long river boundary. A new and unprecedented principle of law for the establishment of river boundaries came into being when the U.S. Supreme Court declared that the boundary between Oklahoma and Texas was to be determined by the "medial line" between gradient lines on each bank of Red River. Prior authority for such a ruling did not exist. Boundary Commissioners Arthur D. Kidder and Arthur A. Stiles were largely responsible for the proper location of the lines as decreed by the court.

In 1919, General Land Office surveyors were working on a survey and examination on behalf of the Indian allottees along the north bank of Red River within the Red River oil field. The situation was touchy because the question of jurisdiction with respect to the boundary between Texas and Oklahoma was as yet unsettled where the boundary survey had not yet been completed.

Armed guards were employed at some of the oil claims, and the situation hovered on the brink of open warfare on the morning of October 18, 1919, when an unsuspecting survey party went out to work as usual. The crew was in an Indian Agency automobile plainly marked "U.S." when it crossed the Red River over the Grandfield Bridge to the south side. After parking at a fence that enclosed a guarded claim within the bed of Red River, the survey party began to assemble the instruments for the day's work, which was in the area just beyond the enclosure.

The men were still beside the vehicle when a guard approached on horseback and gave them orders not to cross the enclosure. He threatened to kill anyone who went any farther. The guard then rode away and came back shortly with a second guard. Both were armed with rifles. Assistant W. O. Tarr, who was in charge of the survey party for the day, explained the survey party's presence. His explanation apparently did not satisfy the guards, one of whom clubbed Tarr with the barrel of his rifle. The guards tossed Tarr's instrument over the fence and ordered the survey party to leave, adding that Tarr would be killed if he came back.

When the incident was reported to the authorities, criminal action against the guards and their employer was recommended. It was a reasonable idea, but, as Arthur Kidder pointed out, until the surveyors completed the boundary survey, then underway, there was no way of knowing whether Oklahoma or Texas courts would have jurisdiction in the matter.⁵³

ALL ABOUT SURVEYORS

Not Surveyor Material

Further evidence that the work of the Field Surveying Service is highly specialized is found in the fact that the Civil Service examination for Surveyors and Transmitters held on March 26th and 27th [1919], failed to establish any appreciable eligible list from which appointments to these positions may be made. A second examination was held on April 23 and 24, but the results of this examination are not yet known. The Supervisor of Surveys has recommended the appointment of a limited number of Temporary Transmitters in order that the work of the Surveying Service may not fall behind.⁵²

Early in 1918, Frank M. Johnson offered a young man a job on William H. Thorn's crew in Arizona. The young man replied by telegram: "Considering salary and expense season in Arizona desert no inducement."

In a subsequent letter to Thomas Havell, Johnson managed to be quite philosophical about the young man's refusal:⁵⁵

Everything, however, seems to always turn out for the best. . . . His telegram convinces me he is hardly the man for our work. I am this day sending to Thorn a young man whose telegram reads:—"Anywhere, the rougher the better." Somehow I can't help but warm up to the man who is willing and anxious to take his chances and rely on his own brains, nerve and energy to get ahead.

In 1920, G. D. D. Kirkpatrick penned this postscript on a letter to Frank M. Johnson: "Just got a wire from Voigt that his only experienced man quit. \$70 & 75 in Nevada will get only a young kid."⁵⁴

Frank M. Johnson once wrote in a letter,⁶¹

I have lost the friendship of many fathers who in a vague way hold me responsible for the shortcomings of their sons on the surveying parties. But this is quite natural. Fathers, however, should remember that failure in one line, especially in such an unusual line as this, does not mean failure in other walks of life, and is no reflection on their son's intelligence or ability. One of the poorest field assistants we ever had some years ago is one of the foremost playwrights in the country, and there are many other similar cases.

Greener Pastures

May 27, 1920

Mr. N. B. Sweitzer
Asst. Supervisor of Surveys
Neligh, Nebraska

Dear Sir:

Referring to yours of the 20th instant, wherewith you enclose a letter from Mr. Wills, I would suggest that you let me know regarding Kippell just as soon as you hear from him.

What Wills says in the last paragraph of his letter is undoubtedly true. Some of our surveyors have left and are with oil companies in the new fields in Wyoming. They were promised big salaries, which they will undoubtedly get if the fields turn out as expected. I don't blame the boys for going; in fact, I am very much inclined to think that if I were in their position I would go too unless my sober judgement got the better of me. It is just as well to remember that the country is in a bad way and it is not improbable that we are on the verge of a panic. You know what the banks are doing in regard to making loans and curtailing credit. Corporations are having a hard time making any headway, and undoubtedly many of the oil companies and other companies on this order will have to suspend operations. In this event the boys who have left for the big salaries will be out of a job and it is also well to remember that *nothing weathers a financial panic like a Government job*. I am mentioning these things, which of course you know yourself, simply to indicate that the Government job has some advantages which other jobs may not, in view of the situation, continue to enjoy.

I return herewith Wills' letter.

Very respectfully,

Frank M. Johnson
Supervisor of Surveys⁶⁰

Characteristics of Ideal Types of Surveyors

On September 23, 1926, John P. Walker, then assistant supervisor for District No. 7 (Oregon and Washington), sent Frank M. Johnson a description of the sort of man required for survey work in Alaska: "The ideal man in my estimation would be one of five or six years of experience, young, husky, not afraid of work, resourceful. . . ."⁵⁸

That year a surveyor meeting those requirements, Floyd G. Betts, transferred from Olympia, Washington, to Juneau, Alaska.

In 1918, William B. Douglass was among those surveyors recommended for promotion by Alonzo Compton.⁴⁶

Mr. William B. Douglass has been in the service about 15 years, and was in the Geological service about 8 years previous to that. Mr. Douglass is a surveyor worthy of the highest respect from the stand point of industry, sincerity, absolute honesty and dependability, loyalty and faithfulness to the Service. Mr. Douglass is a hard worker and is improving in the quantity of work he turns out. He has labored under an almost painful exactness in monumentation, blazing, instrumental adjustment, etc., in his surveys. Mr. Kirkpatrick remarked to me when he left the New Mexico district that "if he wanted the absolute facts in an examination, without fear or favor, he would get them when he sent Douglass."

Promotion Recommendations

When the assistant supervisors of survey made recommendations for promotion or transfer, they were sometimes painfully blunt in their appraisals. One man who was recommended for an increase in salary was characterized as: "A hard, fast worker; not very intelligent but pounds out a lot of work."⁴⁷

Another deserved a promotion because, even though he made a mistake now and then, he had "done a lot of mean, thankless fragmentary work in California."⁴⁷

When surveyor Fred Mench was being recommended for a temporary detail to the Washington, D.C., office, his supervisor wrote:⁴⁹

I do not think you have ever met Mr. Mench and probably have him pictured as the rough, uncouth mountaineer he has been described. However true this may be when he is in the field, when he is in the office, while not a stylish dresser, he is always well and neatly dressed. He is a very quiet man but when he opens his mouth to say anything it is well worth your while to listen. I would rather trust his judgment on surveys than any of the other surveyors working in this district.

Once a Surveyor, Always a Surveyor

During the summer of 1921, Frank S. Spofford described the areas then being surveyed in Washington State as "probably the most difficult to survey of all the work being done in the country today. The townships being surveyed are located on or near the summit of the Cascade Range which extends North and South through the state. These mountains are grand from a picturesque point of view but from the surveyors' standpoint they are a hard proposition."⁶⁰

In spite of such difficulties, however, some surveyors loved their work so much that they never thought of retiring. Frank Johnson once wrote to a colleague: "By the way, I heard the other day that old man Brunt is hale and hearty, and hoping that some day he will get back on the work. It seems to me he must be about 90 years of age at this time."⁷¹

EDWARD T. BEST

Edward T. Best, U.S. transitman of District No. 3, resigned from the surveying service and was sent to France, where he took part in the Battles of St. Mihiel and the Argonne Forest. Later, Best was designated acting sergeant in the Battalion Intelligence Section of the 355th Infantry at Beauclair, France. On November 4, 1918, the section was ordered to leave the house in which they were stationed. Best stepped into the street just as a shell exploded. Four men were killed and several were wounded, including Best, who lost the sight of one eye. Seven days later—November 11, 1918—armistice was declared.⁵⁰

In June of the following year, 1919, District 3 reported:⁵⁰

Nebraska has had six weeks of nearly continuous rains, which reminds one of dear old Oregon. Transitman Leo Peterson, who is on an island survey, reports the Niobrara River in that state as "looking like the Pacific Ocean."

First Lieutenant Fetz and Sergeant Best, lately of France, now U.S. Surveyors again . . . are gearing up the trucks and adjusting transits for sand hill resurveys.

A. PARKER WARNER

The following members of the Field Surveying Service are now on detail at Washington in the Surveying Division of the General Land Office: David W. Eaton, A. Parker Warner, Joseph C. Thoma, Roy E. Chase, Robert W. Livingston, Eimer F. Strickler, William H. Richards, Jr., Alonzo H. Adams, Francis W. DuBois and Earl G. Harrington.⁶⁹

Surveyors were (and are) often detailed to various areas. There is a persistent story about an incident said to have happened in May 1922, when A. Parker Warner was detailed to Utah for a season. Surveyors who knew both Warner and George D. D. Kirkpatrick believed the story, although now it cannot be entirely verified. It has been handed down by several oldtimers and goes something like this:

A. Parker Warner, a Montana party chief, was detailed to Utah for the survey season and was to report to Kirkpatrick, the assistant supervisor of surveys. He reported as directed, and someone pointed out Kirkpatrick's office. Warner stood in the doorway for several minutes and cleared his throat, but Kirkpatrick, who apparently could be arrogant and pugnacious on occasion, would not look up. Kirkpatrick continued to ignore Warner. Finally, Kirkpatrick looked up with a frown and asked, "Who the hell are you and what do you want?" Warner, whose patience was gone by that time, answered, "I'm A. Parker Warner and I don't want a goddam thing." With that, he turned on his heel and walked out, and—depending on the teller of the tale—he could not be found for 2 hours, 2 days, or 2 weeks.¹⁶⁰

(When Kirkpatrick made the customary report showing the names of surveyors who were at work in the field in his district on May 15, 1922, A. Parker Warner's name was on the list for Utah.)⁵⁹

WOODBURY ABBEY

Woodbury Abbey, Cadastral Engineer, and E. C. Guerin, Transitman, are engaged in sectionizing the Chilkat Valley in the vicinity of Haines, Alaska. The U.S. Coast and Geodetic Survey triangulation system, which has so often served as a basis for the computation of position of segregated groups of surveys under the three primary systems in Alaska, has again been called into service. The position of the initial point of the Chilkat Valley surveys was determined from the Coast Survey monuments in the vicinity of Haines and referred to the Copper River Base and Meridian. The extension of the rectangular net to this section of the country will not only take care of the homesteaders already there, about fifty in number, but will undoubtedly stimulate settlement and contribute to the general knowledge of the country.⁶³

Earlier, Woodbury Abbey had a very close call. The steamship *Sophia* sank in the Lynn Canal, in Southeastern Alaska. Among those lost were three field assistants who had worked for Abbey in the Alaskan Interior and were on their way home at the end of the season. Only the fact that the *Sophia*, a

British ship, was not allowed to carry passengers between Alaskan ports saved Abbey from the same fate. He was waiting in Skagway for a ship to take him to Alaska's capital, Juneau.⁵¹

GUERIN AND THE HAZARDS OF THE AUTOMOBILE

By 1930, Eckley C. Guerin (then cadastral engineer in charge at Juneau, Alaska) had been driving automobiles for several years without an accident, as had his oldest daughter.

One day, however, a woman in Juneau smashed into the Guerin car—hit and run. As the damage was not great and no one was injured, Guerin had the car repaired and said no more about it.

Soon afterward the same woman drove "across the street intersection where the City Ordinance requires cars to stop before crossing," and again hit the Guerin car, "mashing two running boards, one fender, one door and handle and burying a telephone pole in the top of the car. . . ." Instead of stopping to see if anyone was hurt, she drove to the Guerin home and told Mrs. Guerin that she had run into her daughter. The Guerin car was in the shop for 6 weeks waiting for replacement parts from Seattle. Because Guerin had no wish to offend the lady's husband, a long-time friend of his, he again paid the costs of the repairs—though he did mention the incident to his friend. The man admitted that his wife had bumped his own car "so much that [I] had to get a new one."

Not long after the car was repaired, Guerin rounded a curve on the highway and met a car coming "from the opposite direction . . . at a high rate of speed and on the wrong side of the road. . . ." He took to the ditch "to avoid a head on collision which would no doubt have killed the occupants in both cars . . . she could very easily have avoided hitting me as the road is about thirty feet wide on this curve, but instead she turned toward my car, striking my rear wheel, tearing off the end of my rear fender and guard rail; she went right on down the road and I had to call several times to get her to stop; I had no idea who had hit me until she stopped, got out of her car and called back and asked me 'what is the matter' in a tone of voice that would rile the patience of Jobe [sic]."

Guerin admitted that he lost his temper that time, but he also said that he could not understand why the woman's husband—his long-time friend—had written to Frank Johnson to lodge a complaint against him for swearing at the man's wife when he merely was trying to avoid having his family maimed or killed, "as three time is enough in one season. . . ."⁷⁰

SURVEY INSTRUMENTS

Solar Transit No. 8484

Young and Sons solar transit No. 8484, which has been used in this Service since the inauguration of the Direct System of surveys in 1910, has come in for repairs for the first time [1919]. This instrument was used up to 1914 in Idaho, was sent to Arizona in January, 1915, was returned to Idaho in June, 1915, again sent to Arizona in November, 1915, and sent to Montana in June, 1916, where it has since been used. The care that has been given this instrument both while in use in the field and in transit from one district to another reflects great credit on those to whom it has been assigned.⁹¹

Blout's Solar Transit

Good care was not always sufficient to protect an instrument. The very nature of public land surveys meant that equipment would sometimes be lost or damaged. For example, Sidney E. Blout, then a young U.S. surveyor working in Arizona, was proud of his Buff and Buff solar transit and took good care of it. However, on the evening of May 31, 1916, the singletree on the line wagon in which he was riding became detached from the doubletree and dropped down, hitting one of the mules on the leg. When the frightened mule started to run, this jerked the lines from the driver's hands, and the wagon went careening downhill behind a team of driverless mules.

Blout grabbed his instrument and jumped. Unfortunately, he did not land, as he put it, "in the most graceful style," and the eyepiece of the solar attachment and the guard on the latitude arc struck the ground with enough force to "disarrange the solar parts" to such an extent that Blout was not able to make the adjustments in the field.⁴⁴

Miller's Clinometer

Frederic C. Miller lost his clinometer during a "mix-up" that occurred when he, Osterhoudt, and three assistants were on their way back to camp one Sunday. They were in a mule-drawn wagon and were about halfway home when the wagon crashed through a bridge "about 30 ft. high and about as long." They fell straight to the bottom and the wagon landed upside down. All but one of the men were thrown clear. Although pinned in the wreckage and in considerable pain, luckily the man was not seriously hurt.⁵⁰

Wilson's Solar Transit

During a 1924 California survey, Buff and Buff solar transit no. 9221 slipped out of transitman Roger Wilson's hands, and, unfortunately, into the Klamath River. Although Wilson was "known to be an expert swimmer and diver," the instrument was not recovered.⁶³

TWO CONTRASTING SURVEYOR REPORTS ON THE LAND

Alaska

A recent report of the survey of a farm-homestead, within seventy miles of the Arctic circle, situated between snowy peaks of the Crazy Mountains and saw-tooth heights of Dolomite range, shows how cruel nature sometimes smiles upon the adventurous settler, as evidence of what she can do when she will.

Six generous hot springs well forth in a cluster from the bedrock, in a gulch at the foot of a treeless mountain, yielding a copious rivulet of pure healthful mountain water, which first comes from the volcanic caves below bearing a temperature of 138° F. to warm the rich alluvial soil, where the homesteader has been building, irrigating, draining, planting, sowing, reaping, and selling valuable food-stuff for years past. . . .

The following abstract is taken from a surveyor's field notes:

The quantity and variety of produce from this claim are both surprising and excellent in quality. During my stay there (five days in August, 1917), the following vegetables were served, all of which were grown on the tract:

Beets, carrots, cauliflower, celery, cucumbers, endive, horseradish, lettuce, onions, parsley, parsnips, peas, potatoes, rhubarb, rutabagas, tomatoes, and turnips; also cranberries, raspberries, service berries and wonder berries.

The following were also growing on the land at the same time: asparagus, barley, celery, corn, garlic, kale, kohlrabi, leeks, mint, oats, radishes, sage, spinach and tobacco; all of which mature in the open air.

The output for 1916 was stated to me by the claimant to consist of the produce of the land, to supply all the neighboring mining camps up to thirty miles away, and even some of the river steamers on the Yukon, forty miles away. . . .⁸⁷

Utah

Andy Nelson was not fond of paper work, especially the required reports of conditions in his survey area that tended to be dull and repetitious. He once received word from his superiors asking why no report on the agricultural and livestock-raising possibilities of his survey area had been received. Nelson's reply was short and to the point: "When I have surveyed enough land to support a cow," he wrote them, "I'll let you know."¹⁴⁸

SURVEYORS' TRANSPORTATION

Wagons

Wagon No. 1 was used on Group 43 Nevada this season, and is now in the bottom of Jarbidge Cañon, in the extreme northern part of Nevada. . . . I recommend that it be left where it is and dropped from the property list. . . .⁴⁸

Trucks

Motor trucks have more than justified themselves. One truck is more effective than a wagon and 4 horses and also more economical. It is hard to tell what we could have done without them during the changes of the last three years . . . the motor truck has come to stay for surveys, both for economy and efficiency.⁵⁰

Mules

Perhaps there are few memories of the old days so cherished by the field man as those associated with the faithful, ornery, lovable old survey mule; and indeed there are few incidents of surveying history before the days of the motor truck, in which he did not figure and play a heroic part. The luster of the deeds of Kit and Belle, Buck and Daisy and Punch and Judy has not been dimmed by the passing years. They and others of their kind generally rose to the occasion no matter what it was and won the admiration and gratitude of those dependent upon them.⁵⁵

LEGENDS ABOUT SURVEY COOKS

Shortly after he was named assistant supervisor of surveys for New Mexico, Guy P. Harrington began a district-wide monthly distribution of a series of "Service Letters." One contained this comment:

The position of assistant on our survey parties is almost a trade in itself and is so regarded by many of our assistants who are staying with our work. The oldest assistant in point of service is

Mahlon L. (Doc) Mishler, who first came on our parties in 1914 as a cook and is still holding down his job. "Doc" maintains that cooking is the most important job on a survey party for he says that a transitman or a chainman can be picked up on short notice at any time, but that good camp cooks are scarce. . . . There is not a man in this district with whom he has not worked at some time or other.⁵⁷

The Bear That Was a Stove

There is a tale about another cook in a survey camp in Montana or Wyoming. This particular man had complained long and often about the battered old stove he had to use for cooking. Finally he convinced the party chief (reported to have been one of the Bandy brothers) that a new stove was necessary. When camp was set up in the mountains that season, a new cook stove occupied one corner of the cook tent. The men started work on the line they were running, and, during the first day or two, they saw signs of a bear in the area. One of the surveyors asked the cook what he would do if a bear wandered into camp when the surveyors were away. The cook showed him a gun he had tucked away and told the surveyor that he was not worried about bears or any other wild animals.

Early one morning, before daylight, however, a bear came into camp. Naturally, there was a lot of yelling. The cook jumped out of bed, grabbed his gun, and shot at the hulking black shadow looming inside the cook tent. At the sound of the shots, the surveyors rushed to see if the cook was all right. He was fine, but his brand-new stove was full of holes.¹⁵³

The Cook Who Was No Cook

In marked contrast to men like Mishler, some cooks did not last long. Wrote Kirkpatrick to Johnson, "[—] has been out on our parties and is not worth a damn. . . . He claims to be a cook, but is a joke."⁵⁴

DISCOVERIES—REAL AND NOT-SO-REAL

Rainbow Bridge National Monument

In the early autumn of 1908, Deputy Surveyor William Boone Douglass, then 44 years old, started to survey the White Canyon Natural Bridges in the southeastern part of Utah. A Paiute Indian then called "Mike's Boy," but later known as Jim, was working as axeman on Douglass' survey party. Mike's Boy told Douglass of a great rainbow-arched natural bridge that was located "near the

Navajo Mountain." This was reported to the General Land Office on October 7, 1908. About 2 weeks later, the commissioner of the GLO instructed Douglass to investigate the reported bridge. If he found it worthy, he was to segregate it.

The snow that fell during the winter of 1908-9 made it impossible to carry out the commissioner's instructions immediately. While he waited for better weather, Douglass made more inquiries but learned nothing more of the bridge. Later that year Douglass was again instructed to seek out the reported bridge, and to segregate it if he thought it to be of sufficient interest to become a National Monument.

Douglass left Bluff, Utah, in early August 1909, to continue his search for the bridge. His party consisted of John R. English and Jean F. Rogerson, chainmen; Daniel Perkins, flagman and packer; and John Keenan, flagman. Jim (or Mike's Boy) was their guide. When the survey party reached Oljato, Utah, they met other bridge hunters—a professor and three students. The two parties continued together. Later, another guide, Masja Begay, was hired. Also a Paiute Indian, he was more familiar with the area than Jim was.

He took them along crude Indian trails. Soon the horses could not continue on the narrow trails with full packs, and the survey party was forced to leave behind all but a bare minimum of provisions.

They sighted the bridge on the morning of August 14, 1909. Douglass, the chainman, and the flagman were the only ones in the combined party who actually reached the top of the graceful natural bridge that arches, rainbow-like, across a

span of 278 feet. It stands 309 feet above the little stream that winds through the deep and jagged gorge beneath it. Rainbow Bridge is only 33 feet wide, and the arch is just 42 feet thick. It is located 4 miles northwest of the towering Navajo Mountain. It is N. 60° 25' W., 7 miles, 65.87 chains from milepost 179 of the Utah-Arizona boundary line. Due to the perseverance in their quest, Rainbow Bridge was preserved as a National Monument.¹⁰⁹

Craters of the Moon

In 1924, Murray D. Badgley, a technical assistant in Boise, Idaho, took particular exception to an article entitled "First Expedition through the Craters of the Moon," which appeared in the March issue of the "National Geographic."

When Badgley read the article, he immediately fired off an angry letter to the editor. In it he pointed out that the author of the article was *not* the first person through the region. Some 50 years before, in 1873, Allen M. Thompson, a U.S. deputy surveyor, had surveyed the Boise Base Line across the area containing the craters. Badgley also pointed out that monuments set by Thompson at that time were still "in excellent preservation and easily found." Further, the author of the article was well aware that Government surveyors had preceded him, although he gave them no credit. In fact, he had stopped at GLO's surveying headquarters in Boise and obtained copies of the "official maps showing the boundaries of the lava beds, roads, trails, water holes, and some of the craters . . ." before he started out on his trip of "discovery."⁶⁵

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THE BUREAU OF LAND MANAGEMENT

GLO ORGANIZATION

During the early years of the direct system of surveys the General Land Office was made up of the following six units: the Washington Headquarters Office, the Offices of the Surveyors General, the District Land Offices, the Field Service, the Surveying Service, and the Logging Service. The commissioner, the assistant commissioner, the recorder, the surveyors general, and the registers and receivers of district land offices were all appointed by the President of the U.S.

As organized at that time, a division in the headquarters office had general control of all cadastral surveys on public lands, no matter what the managing agency was. The surveying service, under the leadership of the supervisor of surveys, executed cadastral surveys in the various surveying districts into which the country had been divided. All instructions for surveys issued in the field were examined in the Division of Public Surveys. In the early days of the direct system, the division chief was Charles L. DuBois. W. T. Paine was the assistant chief, and the commissioner of the General Land Office was Fred Dennett. Fred W. Johnson became the last commissioner of the General Land Office on May 20, 1933.

The Bureau of Land Management

In the summer of 1934, the Taylor Grazing Act was passed, and the Division of Grazing was formed within the Department of the Interior. It was renamed in 1939, and became the Grazing Service. Under the Taylor Grazing Act, all the remaining unappropriated and unreserved public lands, with the exception of those in Alaska, were closed to unrestrained settlement and use. Mining claims could still be staked upon the public lands, and they remained open to outdoor recreation.

Farrington R. Carpenter was the first director of the Division of Grazing. One of his first responsibilities was the classification of the lands, which were mainly in 10 Western States. This presented something of a problem, because neither Carpenter nor anyone else seemed to know just where the public lands were located or how much public land there was. Carpenter found that there was only one place where this vital information was obtainable. The township plats of the GLO showed

the surveys and the private lands had been marked off on the tracts in the local land offices.¹¹⁰

In 1946, the Grazing Service and the General Land Office were consolidated to form the Bureau of Land Management. The director of the new bureau was granted authority, under the direction of the Secretary of the Interior, to perform all executive duties respecting the public lands, including the public land surveys. Fred W. Johnson, the last commissioner of the General Land Office, was named as the first director of the Bureau of Land Management.

Surveying Districts

In the years since the passage of the Land Ordinance of 1785, many changes in the arrangement of surveying districts have been required. Generally, these changes have reflected the enlargement of the Public Domain, the progress of settlement, or the major surveying activities of the period in which they existed.

At the beginning of the Bureau of Land Management, the major surveying activities were centered in the Western States and Alaska. This active area was divided into seven field regions. The direction of the public land surveys was conducted by the regional branches of Engineering and Construction. These branches were under the administrative supervision of a regional administrator. The authority over field operations exercised by each regional branch was limited by the regulations and instructions issued by the director to the various regional administrators.

Now, in the mid-1970's, public land surveys are conducted by cadastral survey branches of the Bureau of Land Management's Service Center at Denver, Colorado, 11 state offices, and the Eastern States office at Silver Spring, Maryland. Authority over field operations is limited by instructions issued by the director of the Bureau of Land Management to the directors of the various field offices.

The Last Supervisor of Surveys

Albert C. Horton, Jr., who had executed the first survey approved under the direct system of surveys, succeeded Frank M. Johnson as United States supervisor of surveys. He was thus the third and last person to hold that title. For, on July 16,

1946, President Truman issued executive Reorganization Plan No. 3 and the office of supervisor of surveys ceased to exist. The plan also abolished the offices of commissioner, assistant commissioner, and registers of the General Land Office, along with those of the director and assistant director of the Grazing Service. Functions of the 134-year-old General Land Office were combined with those of the 12-year-old Grazing Service to form the Bureau of Land Management.

Though his duties and responsibilities remained unchanged, A. C. Horton became acting chief cadastral engineer. Earl G. Harrington was named acting assistant chief cadastral engineer. In 1946 the Public Domain consisted of the 480 million acres that remained after 150 years of transfer policy, of being held in trust, opened to settlement, and used mainly at the behest of individuals. The reorganization plan that assigned responsibilities to the Bureau of Land Management for "the major portions of the multiple-use federally owned lands now held by the Department of the Interior" made it clear that, under the new agency, the public lands were to be administered with an emphasis on multiple uses and public, rather than private, interests. A new era was dawning.

Even so, for cadastral surveyors, many of the problems remained the same as those faced at the beginning of the rectangular system.

GETTING THERE

The rectangular survey system extends across the land in huge networks of lines. These are not imaginary lines; they are real lines that have been surveyed by many men. They cross open prairies, swamps, canyons, and mountains. They are blazed through forests and cut narrowly through nearly impenetrable brush. They are marked by stakes, pits, mounds, marked stones, or iron posts. They were marked by men who followed straight lines because the system provided for in the Land Ordinance of 1785 required that the public land be divided into "townships six miles square, by lines running due north and south, and others crossing these are right angles." There was no mention in the ordinance of just how they were to travel those straight lines, nor was there any mention of how they were to get to the survey area to begin their work. "Getting there" has been a problem since the beginning.

Distance

The field of surveying operations was (and is)

sometimes hundreds of miles from the office issuing the surveyor's instructions. Distance is one of the facts of life with which public land surveyors have always had to deal, whether they were deputy surveyors working under a surveyor general, or U.S. surveyors or cadastral engineers working under an assistant supervisor of surveys, or U.S. land surveyors receiving instructions from a cadastral survey branch chief.

Supplies

Even in the earliest days of the rectangular system, the surveyor, his assistants, the equipment and supplies—sometimes enough to last for several months—had to be transported to the survey area. In the early years, flour and pork were bought by the barrel. Bushels of beans and dried apples were purchased, along with pounds of coffee or tea, salt, pepper, sugar, rice, oatmeal, and saleratus. Seventy pounds of coffee and 10 pounds of saleratus were enough to last a six-man party 4 months.⁸

As early as June 1797, there were written complaints. Israel Ludlow had trouble getting supplies in Ohio, so he planned to drive "two or three small cattle to furnish ourselves with provisions. . . ."⁹ On occasion, supplies were augmented by wild game and/or fish. If the surveyors were lucky, they could find wild honey. By and large, however, deputy surveyors had to transport themselves, all their supplies, their instruments, plus the camp and other equipment. The means of doing so varied according to the circumstances and the times.

In 1821, when Hervey Parke first went to Michigan to become a deputy surveyor, he used the classic, time-honored method of getting there—he walked. Sometimes the men were able to make use of waterways, traveling by boat or canoe. More often, since the surveyor's path is a straight one, the waterways were in the way. Horses and wagons were suitable for some areas, but their use was not always beneficial. Even in reasonably level open country, sand and bogs and rivers that had escaped their banks were factors that had to be taken into account.

In the early days, packmen used a "portage strap." It was made of leather and was usually about 10 or 12 feet long. The strap consisted of three sections—the middle one of which rested on the packman's forehead or chest. The middle section was about 2 feet long and 3 inches wide in the center, tapering toward both ends. Leather thongs were fastened to the ends of the center section, which were tied around the pack.

A packman using a portage strap could usually carry between 75 and 125 pounds.⁵² There were, however, some exceptions to the rule. In 1875, when Nathan Bulter ran the east boundary of the Red Lake Indian Reservation in Minnesota, he employed as packer "one Jack Bonga, of Red Lake. . . ." Bonga regularly carried two sacks of flour (100 pounds each) "rather than make two trips for the same baggage." The regular pack for a horse in similar country was 200 pounds.⁵³

As the surveys extended westward and the country became more open, saddle horses and pack animals carried the men and their surveying and camping gear. Years later, when there were sufficient roads and trails, the surveyors used wagons and buckboards.

A CHANGING WAY OF LIFE

Transportation was one of the things that was profoundly changed by World War I. In 1918, N. B. Sweitzer wrote:⁵⁴

There is no question in my mind but that the truck will do any work that horses or mules will do, in this district, with the addition of a greater radius of action and for less cost per mile. They are cheaper and far more convenient at practically every angle. This is going to be emphasized more and more every year as the cost of hay and grain advances as well as the cost of labor and maintenance in work connected with mules.

In 1919, George Kirkpatrick reported that he was "having great trouble getting wagons repaired and mules shod, and are paying great prices for what we do get. The automobile is driving out the country blacksmith—or at least he is becoming an automobile repair man."⁵⁵

Later that year, another assistant supervisor of surveys wrote:⁵⁶

The distance covered by these heavily loaded trucks [two light capacity Dodge motor trucks] was about 322 miles and the time consumed in going from the field in Wyoming to Denver, including all stops for sleep, meals, and official business, was about 31 hours. Besides the saving of time, which is the very essence of efficiency in this Service, the saving in direct cost over the old way is considerable; the saving in ultimate cost is enormous.

All these factors seemed to bear out Sweitzer's opinion that, "The motor truck has come to stay for the field surveying service and has justified the

recommendation and claims made by those in authority, both as to practicability and economy."⁵⁷

During the 1918-19 winter, topographic engineers, in cooperation with the Air Squadron at Fort Sill, Oklahoma, successfully produced an aerial mosaic of an extensive area in that vicinity. The section lines of the cadastral surveys, along which roads had been built, served as control, since they were clearly visible from the air. The end result of this mapping experiment was a composite map showing in great detail and with unusual clarity the culture and topography of the area—all related to the cadastral survey.⁵⁸

Not that transportation difficulties had really been solved. Near the end of 1921, George Kirkpatrick reported that there had been some complications in his district during what he characterized as having been, on the whole, a good season:⁵⁹

We have suspended work on the Lake Shore investigations and still have more work to do in the field. It has not proved a bigger job than we anticipated—so far as technical procedure is concerned—but is proving more expensive. The trouble is getting around. The country is afflicted with the same trouble as the Mississippi, according to our friend Mark Twain, the country is not thick enough for agriculture but too thick for boating. The result is that we can neither walk, ride, or boat around. In some localities where the mud is just right it will take an able bodied man an hour to walk a mile.

Even where it was still being used, wagon travel was not without its hazards. In November 1921, Alonzo E. Compton reported:⁶⁰

. . . this transit should go to the factory . . . for a general overhauling and repair of damages received from a fall. In fact it fell from the top of a load of loose hay when the team ran away, pitching the assistant who was carrying the transit to the ground. . . .

Communications

Communication methods were also being improved. In 1925, Frank M. Johnson wrote:⁶¹

As soon as you have been advised of the assignment of space for your offices under consolidation effective July 1, you will be authorized to enter into contract for telephone service, without waiting to take actual possession of the offices. Please submit your

recommendations in this matter as soon as you are in position to do so.

In arranging for telephone service it will of course be understood that no provision should be made for any branches [extensions] not absolutely necessary for the proper conduct of public business. No branches should be installed in the drafting and the engineers' rooms.

Airborne Surveys

That same year, George A. Parks planned to furnish cadastral survey information to be used in establishing control for a proposed aerial survey of the islands in Southeastern Alaska. According to the proposal, three large planes were to be operated from bases established along the Inside Passage.⁶⁴

Often, even now, the men themselves must carry their own supplies and equipment for some distance. This was, and is, especially true where rugged terrain or swamps render other forms of transportation impossible to use. For example, no wheeled vehicle—wagon or truck or even four-wheel drive—can make it through some of the really rugged and remote canyon land that surveyors must traverse.

Finally, surveyors and officials began to discuss the feasibility of using helicopters to move the surveying crews and their equipment across terrain so broken and upended that crossing it seemed all but impossible. In 1956, a limited helicopter operations test was made with results so encouraging that a substantially enlarged cadastral surveying program was undertaken during the 1957 field season. The experiment was more successful than anyone had anticipated it would be.

In the deep, steep, rugged, and remote parts of Utah where this method was first used, conventional surveys had cost about \$155 for each mile of line surveyed, with each crew covering an average of 1.2 miles per day. With helicopters, the cost of each surveyed mile was reduced to about \$125, with the crew averaging about 2.6 miles per day—a 20 percent saving in cost, with the surveying output more than doubled. These results clearly indicated the practicality of the use of aerial transport in areas where large-scale surveys had to be made over terrain too rough for trucks and jeeps.¹⁴⁸

CONTINUING LEADERSHIP

Clark Gumm

Much of the credit for the success of the cadastral surveying program in the Bureau of Land Management rests with men who began their careers before the BLM came into being. William Teller, retired chief of cadastral surveys for the Denver Service Center, is one such man. Another, Clark Gumm, became a field assistant on a cadastral survey crew in New Mexico in 1933. In 1936, after he had passed a written Civil Service examination, he was appointed a public land surveyor. Gumm, who attended the Colorado School of Mines, demonstrated both an unusual interest in the work and a high degree of aggressiveness in his study of prescribed and improved methods and procedures regarding all types of cadastral surveys. Because of this, he was given progressively more complicated field assignments. He handled difficult survey projects such as the 1949 underground survey of a bat cave above the Colorado River in the Grand Canyon, a location accessible only by water.

In 1950, Gumm was assigned the responsibility of investigating conditions and executing a survey of the unallotted Choctaw-Chickasaw Indian tribal lands along the Red River in Oklahoma. The Bureau of Indian Affairs had requested the survey of these lands—some 60 isolated tracts of irregular description extending through 25 townships and along both the Texas and Oklahoma sides of the Red River west from the Arkansas State line for about 175 miles. The manner in which Gumm handled this unusual survey brought approval from the Indian bureau and credit to the BLM.

During the early 1950's, Gumm was assigned to the International Cooperation Administration in Iraq as advisor to the Iraq Government on cadastral surveys and related land reform matters. When he returned to the U.S. in October 1954, he was assigned to the Area Cadastral Survey office in Denver. During 1957 he was in charge of a double survey party working on important resurveys in New Mexico when he was selected to fill a vacancy in the Cadastral Engineering Unit in Washington, D.C. In 1961, he was named chief of the Branch of Cadastral Engineering (under C. E. Remington, who was chief of the Division of Engineering).

When the Division of Cadastral Survey was formed by a reorganization in late 1968, Gumm became the chief of the Division of Cadastral Survey.

Clark Gumm's wide and diversified experience made him one of the most knowledgeable and highly respected surveyors in this country. In 1974 he was named assistant to the assistant director of Technical Services, BLM, a position he held until his retirement later that year.

Thomas A. Tillman

Another man who deserves much credit for his accomplishments in the BLM is Thomas A. Tillman. He, too, began his cadastral surveying career in a time-honored manner: on June 8, 1936, he went to work as an axeman on an GLO survey party. Tillman was 18 years old and had just graduated at the top of his high school class in Pendleton, Oregon.

Tillman worked hard and learned quickly. By the 1938 season, he had been promoted to the position of principal assistant. When that survey season ended, he began his studies at the University of Washington. Tillman followed this routine for the next few years. His routine was interrupted by World War II. When Tillman returned from military service in 1945, he, with admirable single-mindedness, resumed his duties as principal assistant with cadastral survey crews during the field season and his formal education during the rest of the year, receiving his degree in civil engineering in 1948.

That same year, Tillman was given a permanent appointment as a cadastral engineer, and began advancing rapidly to positions of increasing responsibility. In 1955 he became assistant to the area cadastral engineer and in 1961 he was named

chief of the branch of cadastral engineering for the States of Oregon and Washington.

In 1964 Tillman was selected as one of a four-man team to update the "1947 Manual of Surveying Instructions." It was soon apparent that what had first appeared to be a fairly minor updating project was going to be, of necessity, a complete revision.

At about the same time, the Washington office was going to be understaffed because of retirements and the growing demands of other departments. Again, Tillman was the choice to fill the void. He was transferred to Washington, D.C. Several times, Tillman's interest in cadastral history, along with his superb knowledge of cadastral law, created a demand for his expert testimony.

Even though Tillman's contribution in rewriting and updating the 1947 Manual and the manual supplement, "Restoration of Lost or Obliterated Corners," cannot be overstated, the intangible benefits initiated by him in training and influencing surveyors will have even more far-reaching effects.

Although many cadastral surveyors over the years have been forward-looking individuals, it is unlikely that anyone was able to foresee one dramatic effect of the cadastral surveys of the public lands. It was an effect certainly not anticipated by the men who were there at the beginning of the rectangular surveys, even though a similar effect had been brought about by the land use pattern under the ancient Roman system of subdivision. During the mid-1960's, as part of the NASA Gemini space program, Gemini V took photographs of Earth from a distance of about 100 miles up. In the photo that showed the Imperial Valley of California and the northern part of Mexico, there was only one visible man-made feature—the rectangular land use pattern created by the United States cadastral survey system.

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INDEX

A

Abbey, Woodbury, 208
 acts, Congressional
 1800, March 1, 36
 1800, May 10, 36, 37
 1802, April 30 (Ohio Enabling Act), 39
 1804, March 26, 48
 1805, February 11, 37, 48-49 1820, April 24, 59
 1830, May 29, 59
 1836, July 4, 112
 1842, August 4, 56
 1849, March 2, 56-58
 1850, September 28, 56-58
 1860, March 12, 56-58
 1862, May 30, 112
 1864, July 2, 91
 1864, May 17 (Alaska Organic Act), 146
 1867, February 8 (Dawes General Allotment Act), 98
 1897, June 4, 93
 1898, April 29 (Arkansas Compromise Act), 56, 57
 1899, March 3, 147
 1905, February 1, 93
 1909, March 3, 109
 1918, September 21, 109
 1925, March 3, 80
 1980, July 14, 109
 Adams, Alonzo H., 207
 Adams, John D., 161
 aerial photography, 150, 151, 215, 217
 agro centuriato, 2
 airborne surveys, 151, 216
 Alaska
 produce, 209-210
 purchase, 145-146
 state selection surveys, 150, 151
 statistics and early history, 145
 survey camp, 190 (photo)
 survey party, 181-182 (photos)
 Allison, W. J., 89
 Allen, J. S., 43
 Allen, Russell K., 162
 Anderson, Alex, 62
 Apian, Peter, 5
 Applegate, Jesse, 66
 Arizona Initial Point, 89-91
 Arizona survey camp (1916), 126 (photo)
 Arkansas survey camp (1915), 130 (photo)
 Armstrong, Moses K., 88
 Armstrong, Ray D., 195
 arpent, 73
 assignment instructions, 107
 assistant supervisors of surveys, 103
 astrolabe, 5
 Atkins, Barton, 146
 auxiliary guide meridians, 51
 auxiliary standard parallels, 51
 Averill, Dupree Reed (Herk), 81, 155, 157, 183 (photo), 186 (photo), 195

B

Badgley, Murray D., 211
 Bail, Horatio, 53
 Bandy, Inez, 121 (photo)
 Bandy, Richard E. (Elmer), 115 (photo), 196, 197
 Bandy, W. R. (Roy), 111, 174 (photo), 178 (photo), 195, 196-198
 Bandy, Willie W., 196, 198
 Bandy survey camps and crews
 Big Horn Mountains (1912), 136 (photo); (1914), 124 (painting)
 Missouri River Breaks (1916), 130 (photo)
 Montana (1914), 133 (photo); (1921), 119 (photo)
 Yellowstone Park boundary (1931-1932), 167, 169, 170, 176, 180 (photos)
 Bandy-Parker-Eaton survey camp, Montana (1922), 166 (photo)
 Banker, Isaac A., 62
 Banneker, Benjamin, 6 (illus.), 21-22
 Barber, A. W., 112
 Bates, Thomas Walter, 205
 Battle Creek, Michigan, 54-55
 Benson, John A., 94
 Benson Syndicate, 94
 Bering River coal field, 148
 Bering, Vitus, 145
 Berlin, Leonard M., 149, 150
 Best, Edward T., 207
 Betts, Floyd G., 149, 207
 Between the Miami Rivers North of Symmes Purchase, 27, 28
 biblical references
 corners, 38
 land measurement, 1, 2
 surveying party, 38
 Biggs, Uriah, 43
 Biggs, Zacheus, 36, 38
 Black Hills
 gold rush, 83
 photos, 122, 123
 Blout, Sidney E., 209
 Boone, Daniel, 42
 boundary surveys
 Ellicott's Line, 21
 Ellicott's Line of Demarcation, 22
 Florida-Alabama, 55-56
 Four Corners, 202
 Georgia-North Carolina, 23
 Illinois, 58
 Oklahoma-Texas, 205-206
 U.S.-Canadian, 23, 82-83
 Wyoming, 88-89
 Bouquet, Col. Henry, 16
 Briggs, Isaac, 47
 Brown, Arthur W., 154, 195, 196
 Brunt, Arthur H., 196, 197
 Brunt, Col. Samuel W., 116 (photo), 156, 196; survey party (Meeteetse, Wyo.), 116 (photo); survey party (Sunlight Basin, Wyo., 1907), 117 (photo), 207
 Buck, Nelson, 89
 Buckingham, Ebenezer, 42-43

Buffalo Trace, 42
 Bureau of Land Management (BLM)
 continuing leadership, 216-217
 inauguration of, 213
 Burt, William A., 54, 62-64, 155-156
 Butler, Nathan, 62, 64
 Butler, Robert A., 50, 55, 56

C

Cabot, John (Caboto, Giovanni), 5
 Cadastral Engineering Service Conference, Denver (1923),
 142-143 (photo)
 cadastral surveys, basis of, 107
 Calhoun, John, 59
 Calvin, Elmer D., 168 (photo)
 Campbell, Quintin (Jerry), 134 (photo), 163 (photo), 196; survey
 camp (Wash., 1917), 125 (photo)
 Campbell, Roy, 205
 Canada—U.S. boundary, 82-83
 Carpenter, Farrington R., 213
 Carpenter, H. B., 202
 cessions, state
 Florida, 55
 Thirteen Original States, 14
 chain, 5, 15, 72-73
 chaining, 196
 Chandler, John, 8
 Chapin, Frank W., 81
 Chase, Roy E., 207
 Clark, Abraham, 10
 Clark, Can. George Rogers, 40
 Clark, John A., 89-90, 91
 Clark, Lt. William, 47, 65
 Clawson, Marion, 194 (photo)
 Clement, Donald B., 150, 156, 196
 Clement, Lester L., 196
 Clements, Benjamin, 55, 56
 coal fields, Alaska, 148
 Coast and Geodetic Survey, 145, 146-147
 Coffee, John, 41, 50, 55
 Colorado survey party (1925), 132 (photo)
 Columbus, Christopher, 4
 Compton, Alonzo E., 103, 207, 215
 Conover, W. C., 149
 Continental Congress, 35
 contract system, 36, 100
 convergency, effects of, 18
 Conway, Valentine, 56
 Cook, Ira, 60-62
 Cook, Capt. James, 145
 cooks, 198, 210
 Copper River Meridian, 147
 correction lines, 50
 Cortez, Hernando, 5
 "Cosmographia," 5
 Cragin v. Powell, 107
 Craters of the Moon, 211
 Crawford, Hugh, 175 (photo), 195, 198
 Crawford, Thomas W., 186 (photo), 195, 198
 cubit, 1-2
 Cumming, Fred L., 195, 196
 Cumming, James R., 196

D

Darling, E. N., 202
 Dauphiny, Larry, 149

Davidson, George, 145
 Denriett, Fred, 213
 Depression, 195
 De Soto, Hernando, 5
 De Witt, Simeon, 14, 36
 direct system, 100-101, 153-161
 Dixon, Jeremiah, 12
 "Domesday Book," 3
 Douglass, William B., 207, 211
 Dowse, Edward, 29, 31
 draftsmen, 162
 DuBois, Charles L., 100, 153, 213
 DuBois, Francis W., 207
 Dukes, J. D., 157
 Dunn, J. Pierce, 205
 Dunnington, F. A., 103
 Dwight, Timothy, 8

E

Earth, circumference of, 2, 3
 Eaton, David W., 207
 Elder, Robert, 80
 Ellicott, Andrew, 9 (illus.), 19-23, 47; see also Ellicott's Line,
 Ellicott's Line of Demarcation, and Ellicott's Stone
 Ellicott, Benjamin, 21
 Ellicott City, 21
 Ellicott, Elias, 22
 Ellicott, George, 21-22
 Ellicott, Joseph, Jr., 21-22
 Ellicott's Line, 21, 47
 Ellicott's Line of Demarcation, 21-23
 Ellicott's Stone, 22
 English, John, 140 (photo)
 "Ephemeris of the Sun, Polaris and Other Selected Stars with
 Companion Data and Tables," 113
 Eratosthenes, 2, 3
 Erskine, Robert, 13-14
 Evans, Col. John, 60
 Exum, John W., 41, 55, 56

F

Fairbanks Meridian, 147
 "Federal Register," 205
 field examination of surveys, 98-99
 field notes, typewritten, 156-159
 first direct system survey, 101
 First Principal Meridian (Ludlow's), 39, 47
 Five Civilized Tribes (Cherokee, Choctaw, Chickasaw,
 Seminole, and Creek Indians), 98, 160
 Five Nations, 99
 five-mile townships, 27, 35-36
 Fitzhugh, George, 83
 Fitzhugh, John, 83
 Florida
 cession, 55
 Donation Act, 56, 65
 Everglades, 110-111
 survey crew (1918), 125 (photo)
 Foote, Nathaniel, 5
 Foote, Ziba, 44-45
 Forest Management Act of 1897, 92-93
 Forrest, F. Wayne, 188 (photo); survey party (Utah-Wyo. state
 line, 1948), 185 (photo)
 Four Corners, 202
 Fourth Principal Meridian, 58

Freeman, James E., 78, 80
 Freeman, Thomas, 40-42
 "Freeman's Corner," 40
 Freund, John B., 60
 Frisius, Gemma, 5
 Fry, Joshua, 11

G

Gadsden Purchase, 68
 General Land Office (GLO)
 consolidation with Grazing Service, 213
 establishment, 49
 first commissioner, 49
 organization, 213
 Genn, James, 11
 Geographer, 15
 Geographer's Line, 19, 29, 39
 George, Martin, 148, 161-162
 Gold Rush of 1849, 70
 Goodale, S. W., 162
 Gordon, Harvey, 88
 Gordon, William, 60
 "Gore, The" (Indiana), 39
 Grazing Service, 213, 214
 Great Pyramid, 1
 Greeneville Treaty Line, 37, 38, 39
 Greynville, Sir Richard, 5
 groma, 2
 group numbers, 107
 Groups Nos.
 1, Colorado (1910), 101
 33, Oregon (1917), 126, 129 (photos)
 41, Arizona (1915), 136 (photo)
 62, California (1920), 137 (photo)
 312, Colorado, 184 (photo)
 333, Colorado, 170 (photo)
 Guadalupe-Hidalgo, Treaty of, 67, 74
 Guerin, Eckley C., 148, 208
 guide meridian, 50
 Gumm, Clark L., 150, 192 (photo), 216-217
 Gurley transit, 168 (photo)

H

Haigh, Thomas A., 147
 Hall, Wendell G., 150, 151, 195, 196, 198
 Hall, Wendell V., 195
 Hall system, 150
 Harding, Donald E., 151, 190 (photo)
 Harrington, Earl G., 155-156, 207, 214
 Harrington, Guy P., 91, 155, 161, 177 (photo), 195, 210
 Harriot, Thomas, 5
 Harris, Jerry, 190 (photo)
 Harrison, J. Scott, 161, 197
 Harrison Purchase, 43
 Harvey, W. E., 88
 Haste, Glenn R., 155, 195, 198, 205
 Havell, Thomas, 208
 Hayden, Ferdinand Vandiveer (F.V.), 97-98
 Hayward, Elijah, 112
 Hendricks, Thomas A., 109, 112
 Hermann, Binger, 93
 Herman, Augustine, 8
 Hiester, Tom, 196
 Hiester, William E., survey parties 124, 164 (photos), 196
 Homestead Act, 66

Homestead Entry Survey, 63
 Horton, Albert C., Jr., 101, 102, 103, 154, 158-159, 161, 165
 (photo), 198, 213-214
 Hover sight, 151
 Hudde, Andries, 8
 Huntsville Meridian, 41
 Hutchins, Thomas, 15-16, 19, 29, 31, 32, 33, 49, 111
 Hyatt, Hobart B., 190 (photo)
 Hyde, George, 80

I

Idaho
 Priest Lake (1911), 131 (photo)
 survey camp (1919), 166 (photo)
 Incas, 3-4
 Inch, Philip, 195
 Indian land surveys, 103
 Indian Territory (Okla.), 99
 Indian tribes
 Alaskan, 145
 Choctaw-Chickasaw, 216
 Comanche, 99, 205
 Crow, 197
 Five Civilized Tribes, 98, 160
 Five Nations, 99
 Kiowa, 99, 205
 Potawatami, 92
 Shoshone, 100
 Sioux, 83, 97
 Ute, 97-98
 initial point, public land surveys without, 25-28
 initiating documents, 107
 Instructions to U.S. Deputy Mineral Surveyors, 112
 Interior, Department of the, 71, 72
 iron post, regulation, 104

J

Jackson, John, 38
 Jaekel, Herman, 103, 161, 181 (photo), 198
 Jenkins, John, Jr., 9
 Jenkins, John, Sr., 9
 Jefferson, Peter, 11
 Jefferson, Thomas, 11, 15, 47
 Johnson, Albert, 93
 Johnson, Frank M., 98, 99, 100-105, 115 (photo), 135 (photo),
 148, 153, 154, 157-160, 161-162, 191 (photo), 197, 202-203,
 205, 206, 207, 213, 215-216
 Johnson, Fred W., 213
 Johnston, Theodore O., 139 (photo), 195
 Jones, Lyle F., 192 (photo), 198
 Joy, Francis F., 154

K

Kidder, Arthur D., 64, 99, 100-101, 102, 112, 159-160, 193
 (photo), 202, 205-206
 Kimmel stove, 198-201
 Kimmel, William B., 172 (photo), 195
 Kimmell, Albinus N. (A.N.), 195; survey party (Ala., 1918), 173
 (photo)
 Kimmell, Anthony C. (Tony), 172 (photo), 183 (photo), 195
 Kimmell, Everett H., 195, 202; survey party (Colo., n.d.), 173
 (photo)
 Kimmell, Keith, 195

King, Norman L., 162
 King, Samuel D., 81
 Kirkpatrick, George D. D. (G. D. D.), 103, 161, 206, 207, 208, 210, 215
 Klondike gold rush, 147
 Knowles, John S., 138 (photo), 153, 155, 157, 198

L

Lamoraux, Silas, 112
 land bounties
 1812 land bounties, 49
 Revolutionary War, 14
 land grants
 colonial, 5
 New England, 5
 railroad, 91
 "Land Office Business," 80
 "Land Service Bulletin," 205
 Lange, Bernard (Benny), 138 (photo)
 Leeds, Daniel, 9
 L'Enfant, Pierre Charles, 21-22
 Lewis, A. B., 147
 Lewis, Frank L., 161
 Lewis, Capt. Meriwether, 47, 85
 Lincoln, Abraham, 59-60, 70 (illus.), 71 (facsimile doc.)
 Lincoln, Thomas, 42
 Little Big Horn, Battle of, 83
 Livingston, Robert W., 207
 Lopez de Gardenas, Don Garcia, 5
 Ludlow, Israel, 37, 38, 39, 214
 Ludlow's Meridian, 39, 47
 Lyman, Edward O., 195-196
 Lyman, Lewellyn D., 195
 Lyman, Ranny Y., 195-196, 198
 Lyon, Lucius, 54, 58
 Lyon, Orson, 54, 58
 Lytle, Marvin J., 205

M

Mader, Herman F., 205
 Magellan, Ferdinand, 5
 magnetic compass, 5, 64
 Major, Daniel G., 62
 Major, John G., 202
 Mansfield, Jared, 47, 48, 111
 Instructions, 111
 "Manual of Surveying Instructions"
 Booklet (1919), 64, 158-159
 Evolution of, 111-113
 Manuals
 1855, 50, 51
 1861, 51
 1890, 51, 63
 1894, 63
 1902, 63
 1930, 51, 158-159
 1947, 217
 1973, 113
 Supplements, 113, 217
 Marsh, Capt. James M., 63
 Martin, Absalom, 29, 31, 36, 38
 Mason, Charles, 12
 Mason-Dixon Line, 12, 21

Matanuska
 coal field, 148
 Valley Project, 148
 Mathews, John, 31, 32, 38
 Mathias, Thomas F., 162
 McCord, Alan R., 161
 McDonald, John, 43
 McDonald, Russell, 198
 McManus, M., 87
 medial line, 205
 Meigs, Josiah, 49, 50, 67 (illus.), 111-112
 Mench, Fred, 207
 Mexican border incident, 158-159
 Meyers, J. W., 62
 Michigan Report (1815), 53
 Mike's Boy (Jim), 210-211
 Miller, D., 59
 Miller, Frederic C., 209
 Milltrick, Willis J., 205
 mineral surveyors, 94
 Mining Law of 1872, 91-92
 Mishler, Mahlon L. (Doc), 210
 Missouri River Basin Project, 198
 Missouri River Breaks survey (Mont., 1918), 129 (photo)
 Monday, A., 59
 Montana survey crew (1914), 126 (photo)
 Moody, Zenas Ferry, 80
 Moore, Charles F., 205
 Moore, John M., 112
 Morris, William, 29
 Mt. McKinley National Park
 boundary survey, 149-150
 boundary survey party (1936), 177, 181-182 (photos)
 mules, 153, 158-159, 210, 215
 Mullett, John, 54
 Munro, Fred, 198
 Muskingum River survey, 27

N

Nader, George F., 162
 Naret, Joel Q., 162
 "National Geographic," 211
 Nelson, Andrew (Andy), 156, 187 (photo), 198, 205, 210
 Nelson, Ken, 149
 Nelson, Ralph W., 161
 Nenana coal field, 148
 Neville, Joseph, 19
 New Boston, 69 (plat)
 New Mexico Principal Meridian, 76 (photo of field notes)
 Nile Valley, 1
 Northwest Territory (Ohio), 14, 33

O

Odell, William H., 83
 Ohio
 conflict with Michigan, 27
 land subdivision, 25, 27, 29
 Northwestern, 27
 Seven Ranges, 29-33
 Ohio River Base, Indiana, 27
 Ohio River survey area, 25, 27
 Oregon
 Compromise, 66-67
 Donation Law, 76-78
 Manual (1851), 50, 112
 Territory, 65, 78-80

P

Paine, Walter T., 111, 213
 Parks, Harvey, 53-55, 214
 Parker, Alexander, 29
 Parker, Ernest, 195, 196
 Parker, Horace, 195
 Parks, George A., 148-149, 162, 216
 Patterson, Robert, 21, 47
 peace tree 40, 41 (illus.)
 Pearson, Elliott, 182 (photo)
 Pearson, George W., 81
 Pearson, Grant, 149
 Pecore, Chester W., 205
 Pellum, Barney M., 205
 Pennington, Edward, 9
 Perkins, W. C., 202
 Peterson, Leo, 196; survey party (Wyo., 1935), 179 (photo)
 photogrammetry (Alaska), 150-151
 Pidgeon, C. Chandless, 196
 Pidgeon, Charles M., 196
 Pierce, William H., 91
 Pizarro, Francisco, 5
 Point Lobos survey, California (1940), 166 (photo)
 point of beginning, 19
 Ponce de Leon, Juan, 5
 Porter, Andrew, 13, 13
 Portuguese exploration, 4
 Preston, John B., 78-80
 Preston, Levi S., 202
 Price, N., 138 (photo)
 Proudfoot, Judge S. V., 205
 private claims, 72, 73-75
 Putnam, Rufus, 36, 37, 38, 39, 111

R

Rainbow Bridge National Monument, 210-211
 Randall, Benjamin, 92
 Rands, Ernest P., 103, 135 (photo)
 Raymond, H., 195
 rectangular survey system, 17
 Rector, William, 42
 Red River of the North, 57
 Red River (Okla.), 205-206, 216
 Reilly, P. T., 188-189 (photos), 195
 Remington, C. E., 150, 216
 "Restoration of Lost or Obliterated Corners," 112, 113
 resurveys, 108-111
 Richards, W. A., 88-89, 93
 Richards, William H., Jr., 207
 Rigby, George F., 198
 Riden, Clark O., 54
 Rittenhouse, Benjamin, 13
 Rittenhouse, David, 10 (illus.), 13, 19
 Ritter, Gus, 198
 Robbins, C., 202
 Romberg, Roy, 195
 Rowland, John W., 162
 Ruxton, Albert, 81

S

Saffrey, Solomon, 8
 San Bernardino Initial Point, 81
 Sargent, Maj. Winthrop, 29, 31-33

Sawyer, Glenn F., 121 (photo); survey crew (Missouri River Breaks, Mont.), 119 (photo)
 Saxon, Homer, 196-197
 Saxon, Wesley C., 196-197
 Scioto River Base, 27
 Second Principal Meridian, 39, 40, 47, 48
 sections (numbering of), 25, 26
 Seeley, Charley, 197
 Seibecker, Carl, 157
 Seven Ranges, 19, 25, 27, 29-33, 36, 37
 Seward Meridian, 147-148
 Sherman, Isaac, 29, 32
 Sherman, Roger, 7 (illus.), 10
 Shinn, Major, 112
 Sibley, Sylvester, 54
 Simpson, James, 29
 Sitting Bull, 83
 Sixth Principal Meridian, 87
 Smith, Benjamin H., 64
 Smith, Jeremiah, 43
 Snell, Willebrord, 5
 solar attachment, 64
 solar compass, 63-64, 73 (photo), 75 (photo), 83
 solar transit, 209
 special surveys (Alaska), 151
 Special Instructions, 107
 Spofford, Frank S., 103, 196, 207
 Spofford, Fred, 196
 Sproat, Ebenezer, 32
 St. Stephens Meridian and Base Line, 55
 "Standard Field Tables and Trigonometric Formulas," 102, 113
 standard parallels, 50
 state boundaries, surveyed by GLO, 202
 statistics, public land, 108
 Stiles, Arthur A., 205
 Stoddard, I. W., 195
 Stone, Augustus, 44
 Stone, C. C., 55
 Strickler, Elmer F., 138 (photo), 207
 subdivision rule (erroneous), 109
 survey markers, destruction of, 60
 surveying districts, 103, 213
 "Surveyor, The," 5
 Surveyor General of the Northwest Territory, 111
 Surveyor of the Lands South of Tennessee, 47, 55, 111
 surveyors general
 appointment of, 36
 office abolished, 161-162
 under the direct system, 161
 Sutter, Johann August, 65, 66, 70
 Swamplands
 acts, 56-58
 grants, 56-58
 Sweitzer, Norman B. (N. B.), 100, 103, 110, 153, 158, 161, 162, 206, 215
 Symmes Purchase, 28, 37

T

"T in O" map, 2, 4 (illus.)
 Talcott, Capt. Andrew, 63
 Tallahassee Meridian, 55
 Tallman, Clay, 135 (photo), 159
 Taylor, Douglas W., 95
 Taylor Grazing Act, 213
 Tarr, W. O., 206

Tecumseh, 43
 Teller, Addison R., 196
 Teller, William, 194 (photo), 196, 198, 216
 Ten O'Clock Line, 43, 44 (illus.)
 Tenana Valley, 147
 Texas Purchase, 67-68
 Texas-Oklahoma boundary, 205
 Third Principal Meridian, 59
 Thirteen Original States
 cessions, 14
 governmental authority, 35
 land claims, 14
 Thoma, Joseph C., 193 (photo), 202, 207
 Thompson, Allen M., 211
 Thorn, William H., 147, 206
 Tiffin, Edward
 career, 49, 50, 54, 111-112
 illustration, 68
 Instructions for Deputy Surveyors (1815), 13
 Michigan report (1815), 53
 Tillman, Thomas A., 112-113, 190 (photo), 217
 Timber Culture Act of 1873, 92
 Timber Cutting Act of 1878, 92
 Timber and Stone Act of 1878, 94
 Tippicanoe, Battle of, 43
 Toland, Lloyd, 196
 Torgerson, Herbert C., 149
 Township 5, First Range, 11 (plat)
 townships, 49
 transportation, means of
 airborne, 214-216
 foot, 214
 horses, 214, 215
 mules, 210, 215
 trucks, 210, 215
 wagons, 210, 214, 215
 triangulation, 5
 Tupper, Benjamin, 29
 Tupper, Edward W., 44
 Twelve-Mile Square Reserve, 27

U

U.S. Cadastral Survey Office, Montana, 1930, 171 (photo)
 U.S. Civil Service, 99
 U.S. Coast and Geodetic Survey, 145, 146-147
 U.S. Constitution, 35
 U.S. Department of the Interior, 112
 U.S. Geological Survey
 cadastral survey experiment, 147
 establishment of, 91, 98
 public-land surveys, Indian Land (Okla.), 99
 takeover attempt, 160
 under the GLO, 91, 97, 98
 U.S. Military District, 36, 38-39
 U.S. Military Survey, 27, 35-36
 U.S. supervisor of surveys, 100-102
 U.S. Surveyor General's Office, Montana
 staff, 1890 (photo), 82
 staff, 1909 (photo), 114
 U.S. Treasury Department, 112
 Utterback, Willford, 158-159, 197, 205; survey party (Garland, Wyo., 1905), 118 (photo)

V

VanderMeer, Theodore (Van), 139 (photo), 195
 vara, 73
 Vincennes Tract, 39-40, 42, 43, 44 (illus.), 47, 111
 Vincennes Treaty, 42
 Voigt, Emil, 184, (photo), 194 (photo), 196, 198
 Voigt, Hans, 132 (photo), 138 (photo), 157, 196

W

Wager-Smith, D. R. W., 150, 151
 Walker, John P., 103, 141 (photo), 147-148, 161, 207
 Wampler, Joseph, 53
 Warner, A. Parker, 207-208
 Warner, Claude (Hefty), 195, 198
 Washington, D.C., 21-22
 Washington, George, 6 (illus.), 11, 21, 36
 Washington, Henry, 56, 81
 Washington, state of
 frontispiece
 survey camp (1914), 127 (photo), 135 (photo)
 survey costs, 159
 Wasson, James M., 161
 Wasson, John, 93
 Webster, Kimball, 80
 West Line (Mason-Dixon Line), 12
 West of the Great Miami River, 27
 Wheeler, Courtenay Q., 205
 Wheeler Survey, 1874, 202
 Whispering Willie, 198
 White, C. Albert, 185 (photo)
 White, Ty, 91, 118 (photo), 196, 198; survey (Calif., 1937), 189 (photo)
 White, Van, 118 (photo), 196
 Wilkes, Thomas S., 95
 Willamette Meridian, 77-78, 80
 Willamette State Park, 72 (marker-photo)
 William the Conqueror, 3
 Wilson, Roger F., 132 (photo), 138 (photo), 156-157, 209; survey party (Calif., 1938), 189 (photos), survey party (Calif., 1940), 190 (photo)
 Wiltse, Harry A., 87
 Winkler, Tom, 157
 Wisconsin plat
 aerial photo, 1950, 85
 1849 plat (copy), 84
 Woodward, Nathaniel, 8
 World War I, 157-158
 World War II, 202
 Wright, George B., 62
 Wyoming Valley, 10, 13
 Wyoming-Montana boundary, 77 (field notes, photo)

Y

Yellowstone Park boundary, 197-198
 Yellowstone-Teton region, 97

Z

Zieber, John S., 88

END

5 - 19 - 94